SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 6
MARCH 15, 1970

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD_____iii

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER
Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE
Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION
Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL
Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION
Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING
Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA
Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS
Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES
Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION
Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

02. WATER CYCLE

2A. General

EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
Victoria State Rivers and Water Supply Commission (Australia).
G. N. Alexander, A. Karoly, and A. B. Susts.
J Hydrol, Vol 9, No 3, p 322-344, Nov 1969. 23 p, 5 fig, 2 tab, 24 ref.

Descriptors: *Floods, *Flood forecasting, *Mathematical studies, *Statistical models, Parametric hydrology, Rainfall-runoff relationships, Time series analysis, Regression analysis, Reviews, Hydrology, Frequency analysis, Probability.
Identifiers: *Australia, Flood distributions (Statistical).

The analysis of hydrologic variables for estimating the relation between magnitude and frequency of rare floods is discussed. A survey was made of the relatively unsuccessful search for the most appropriate distribution for floods and for rainfall by statistical examination of observations. It is shown that, using known hydrostatistical relationships between rainfall, losses and floods, the same distribution type cannot in practice be used over the complete range for both rainfall and floods. Location, scale and shape parameters and moment-ratios necessary for the complete description of floods and rainfall are discussed. The moment-ratio diagram is used to give a graphical measure of distribution types. The extreme-value and log-normal distribution are equivalent with a given geometric standard deviation. Methods are given for estimating location and scale parameters. Rainfall can be equally well represented by the log-normal and extreme value distributions even when extrapolated to return periods of 10000 years. (Knapp-USGS)
W70-02046

GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
Norwegian Water Resources and Electricity Board, Oslo. Glaciology Section.
For primary bibliographic entry see Field 02C.
W70-02084

EVALUATION OF ERRORS PRESENT IN WATER BALANCE INVESTIGATIONS (RUSSIAN),
A. G. Bulavko.
Leningrad Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii No 7, p 3-13, 1967. 4 tab, 27 ref.

Descriptors: *Water balance, *Mathematical studies, *Estimating, Moisture availability, Moisture, Evaporation, River flow, Precipitation (Atmospheric), Rain, Drainage density, Runoff, Reservoir storage, Hydrologic properties, Drainage water, Floods, Lakes, Bogs, Forests, Snow, Snowmelt, Transpiration.
Identifiers: Water-balance errors, World hydrologic stations.

The magnitude and character of errors associated with water balance investigations were analyzed. The effects of precipitation, drainage, area, rain, riverflow, spring flood, snowmelt, and vegetation were analyzed and expressed in several tables. The errors in calculating basic elements of water balance can be up to 25%, with 10-15%, 15-20% and 20-25% in using monthly river flows, monthly drainage basin precipitations, and monthly evaporations, respectively. In general it is recommended that in evaluating water-balance concepts the determination of moisture-holding capacity of a river-drainage area should be the first and most important step, and evaporation should be calculated as the residual term. (Gabriel-USGS)
W70-02218

WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
O. L. Markova.
Leningrad Gosudarstvennyi Gidrologicheskii Inst, Sbornik po Gidrologii No 7, p 28-40, 1967. 13 p, 2 fig, 9 tab, 19 ref.

Descriptors: *Water balance, *Runoff, *Karst, River basins, Discharge (Water), Water loss, Evaporation, Precipitation (Atmospheric), Topography, Springs, Water utilization, Water supply, Groundwater gaging, Groundwater.
Identifiers: *USSR, East European Plain, Kama River basin, White Sea basin, Barentz Sea Basin, Volga River basin.

Hydrologic regimes of subsurface karstic and transkarstic regions of the USSR were investigated using hydrologic observations recorded from 1955 to 1965 in the basins of the White Sea, Barentz Sea, Volga River, Kama River, Dniester River, Ay River, and in the drainage basins of the Izhora and Pandiver uplands. The effect of karstic conditions cannot be investigated without taking into consideration the size of a drainage area and the character of interconnection existing between the surface and underground waters in the area under investigation. Moreover, the effect of karst on water balance and normal value of annual runoff is determined by the lack of coincidence between surface and subsurface boundaries of river drainage basins and in transkarstian basins of small dimensions. The balance between the inflow and outflow waters is often of negative character. (Gabriel-USGS)
W70-02219

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
Institut po Proektirovaniiu Predpriiatii Nikelevoi Promyshlennosti, Leningrad (USSR).
P. V. Molitvin.
Leningrad Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot Po Gidrologii No 7, p 14-27, 1967. 14 p, 3 fig, 3 tab, 6 ref.

Descriptors: *Surface-groundwater relationships, *Groundwater, *River basins, *Karst, Fissures (Geology), Geology, Sandstones, Metamorphic rocks, Carbonate rocks, Water circulation, Fluorescence, Mining, Velocity, Water level fluctuations, Runoff, Gaging stations, Discharge (Water).
Identifiers: *USSR, Southern Urals.

Surface water-groundwater relationships were analyzed on the basis of geological and hydrological observations conducted in the Ay River basin of the Southern Urals from 1955 to 1965. Hydrologic observations consisting of the data recorded at the standard gage stations were supplemented by using a fluorescent tracer solution in the artificial canals connecting the mine shafts and tunnels of the area. The future development of mines in the Ay basin to full industrial capacity will induce the flooding of deep mines as a result of induced recharge of stream waters of the area by fissures and general karstic environment. (Gabriel-USGS)
W70-02220

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
Hydrometeorological Service of the USSR, Moscow.
Ye. Sh. Azarkovich.
Leningrad Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii No 7, p 41-48, 1967. 8 p, 2 fig, 2 tab, 4 ref.

Descriptors: *Floods, *Discharge (Water), *Flood forecasting, Discharge measurements, Rain, Runoff, River basins, Hydrograph analysis, Precipitation (Atmospheric), Drainage, Topography, Geology, Soil properties.
Identifiers: *USSR, Volga River basin, Volga River discharge.

Experimental curves of transient coefficients K equals Df/Dmd, where Df is the fixed discharge and Dmd is the mean daily discharge, were analyzed and plotted on the basis of rainfall-flood data recorded during 1940 to 1956 in the upper reaches of the Volga River basin. The experimental curve of transient coefficients versus their drainage areas can be assumed to be of analytical value and should be used in the afforested areas of the Upper Volga River basin. Transient coefficients for the maximum rainfall and snowmelt discharges are quite similar giving 0.5 and 0.2-0.3 for drainage areas of less than 10 sq km and more than 10 sq km, respectively. (Gabriel-USGS)
W70-02221

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
P. M. Lyutik.
Leningrad Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii No 7, p 60-75, 1967. 16 p, 7 fig, 2 tab, 15 ref.

Descriptors: *Rain, *Runoff, *Water loss, *Rainfall-runoff relationships, Floods, River basins, Precipitation (Atmospheric), Discharge (Water), Hydrologic properties, Drainage districts, Infiltration, Evaporation, Hydrograph analysis, Climatic zones, Storm runoff, Frequency.
Identifiers: *USSR, Carpathians, Rainfall-runoff loss, Surface runoff loss.

On the basis of discharge and precipitation data recorded at several gaging stations of the Carpathian Rivers, the rainfall-runoff losses were analyzed by using the standard technique of subdividing a river discharge into the total and basic parts. Flood frequencies, runoff coefficients, precipitation, and water loss volumes were calculated and expressed by charts and tables. The analysis of runoff coefficients indicates an initial loss of water equal to a layer of 40-50 mm in thickness for summer floods and 10-15 mm for spring and fall floods. The hydrologic data record at the Transcarpathian gaging station shows the greatest losses (as much as 90%) after isolated rainfalls in river basins of small areal extent. The smallest losses occur after long intensive rainfall or after a long rainfall period. The majority of rainfalls characterized by maximum discharges have high rainfall-coefficient values (0.60 - 0.90) and occur during the spring and fall months. (Gabriel-USGS)
W70-02222

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
P. M. Lyutik.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst., Sbornik Rabot po Gidrologin, No 7, p 76-84, 1967. 9 p, 1 fig, 1 tab, 15 ref.

Descriptors: *Floods, *Discharge (Water), *Rainfall-runoff relationships, *Flood forecasting, Precipitation (Atmospheric), Gaging stations, Rainfall, Water loss, River basins, Slopes, Velocity, River beds, Vegetation, Mathematical studies.
Identifiers: *USSR, Eastern Carpathians.

Analytical and experimental procedures are given for the analysis of maximum rainfall flood data recorded by several river gaging stations of the Eastern Carpathians. The mathematical analysis is based on the utilization of ultimate runoff formulas and precipitation reduction curves. The results of this study can be safely applied for the determination of rainfall flood discharges taking place in the Carpathian Rivers; however, the best results should be obtained in analyzing the maximum flood

discharges of drainage areas not exceeding 1000 sq km. Somewhat different reduction formulas are suggested for drainage areas exceeding 1000 sq km. (Gabriel-USGS)
W70-02223

METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
Voronezh State Univ. (SSSR).
V. M. Mishon.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst., Sbornik Rabot po Gidrologii, No 7, p 85-91, 1967. 7 p, 4 fig, 1 tab.

Descriptors: *Mathematical studies, *Surface runoff, *Seasonal, *Vegetation, Discharge (Water), Hydrograph analysis, Forests, Water storage, River basins, Snowmelt, Evaporation, Infiltration, Physical properties, Water balance, Ice, Groundwater, Snow, Runoff coefficient.
Identifiers: *USSR, Forest-Steppe zones, Steppe zones.

Spring seasonal runoff was analyzed on the basis of Yunusov's coefficient-of-fluctuation method and hydrologic data recorded in the steppe and forest areas of the European USSR. By introducing additional complex parameters, mainly based on the physico-geographical conditions affecting runoff genesis, the values of the fluctuation coefficients and parameters were computed and plotted. Calculation of variation coefficients of spring discharges using the coefficients of internal annual-flow-nonuniformity and hydrograph curves is a reliable method. (Gabriel-USGS)
W70-02224

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
Akademiya Nauk SSSR, Moscow. Institut Geografii.
A. O. Kemmerickh.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst., Sbornik Rabot po Gidrologii, No 7, p 92-96, 1967.

Descriptors: *Runoff, *River basins, *Discharge (Water), Drainage, Watersheds (Basins), Altitude, Slopes, Velocity, Gaging stations, Flow measurement, Hydrologic data, Maps.
Identifiers: *USSR, Alai Range, Kirgiz SSR, Turkestan Range.

The basic characteristics of drainage necessary for the evaluation of hydrologic constructions and water management in the Alai and Turkestan Ranges were analyzed. A map of annual river discharges as a function of altitude was constructed using the data from 41 hydrologic stations. The area can be subdivided into 4 basin range areas by discharges varying from 0.2 to 3.4 liter/sec/sq km for each 100 m of altitude. The greatest values are found in the upper reaches of the Zeravshan, Pitaukul, and Tamdykul Rivers. In general, the total annual discharges of the Alai and Turkestan Ranges is estimated to be 11.09 cu km or 11.9 liter/sec/sq km. (Gabriel-USGS)
W70-02225

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
All-Union Research Inst. of Water Supply, Drainage, Hydro-Engineering Works and Engineering Hydrogeology, Moscow (USSR).
For primary bibliographic entry see Field 02E.
W70-02226

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
Ukrainskii Nauchno-Issledovatelskii Institut Lesnogo Khoziaistva, Kharkov (USSR).
V. M. Krynskiy.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 108-115, 1967. 8 p, 3 fig, 4 tab, 3 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff, *Discharge (Water), *Rainfall, *Precipitation (Atmospheric), *Moisture content, Geology, Clays, Soils, Water balance, Slopes, Topography, Winds, Porosity, Mathematical studies, Air temperature, Evaporation, Floods.
Identifiers: *USSR, Siberia, Birobidzhan.

By using runoff experimental plots in the Far East region (Siberia), rainfall-runoff and moisture content of clayey grounds was investigated. Geographical, geological, and hydrological data recorded during 1958-1961 were analyzed utilizing a formula of water balance for a single flood. Surface runoff from a series of rainfalls takes place if the moisture content of a one-meter layer exceeds 400 mm. Runoff is characterized by its gradual increase, as a result of additional rainfalls and moisture content increase. The saturation limits of runoff plots are achieved when there is 480 mm of moisture, or 84% of total moisture-holding capacity. (Gabriel-USGS)
W70-02227

RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
Ukrainskii Nauchno-Issledovatelskii Institut Lesnogo Khoziaistva i Agrolesomelioratsii, Kharkov (USSR).
G. P. Surmach.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 116-121, 1967. 6 p, 3 tab, 5 ref.

Descriptors: *Surface runoff, *Land use, *Agricultural watersheds, *Soil conservation, Erosion control, Snowmelt, Soil erosion, Forests, Agricultural engineering, Soils, Precipitation (Atmospheric), Cultivation, Canal construction, Water storage, Groundwater.
Identifiers: *USSR, Orel province, European USSR, Kuibyshev region.

The retention of surface runoff on agricultural lands was investigated on the basis of hydrological data recorded at the experimental runoff plots of the Orel and Kuibyshev regions from 1950-1964. Runoff retention depends on several factors, such as type of soil, type of runoff water (snowmelt, standard rainfall), depth and methods of ploughing, etc. Proper methods of reforestation, canal construction, and better land cultivation should considerably decrease the process of erosion and surface runoff. (Gabriel-USGS)
W70-02228

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
State Hydrological Inst. (USSR).
A. S. Sudol'skiy, and N. A. Davtyan.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 158-165, 1967. 8 p, 5 fig, 1 tab, 3 ref.

Descriptors: *Model studies, *Winds, *Wind velocity, *Waves (Water), Air circulation, Altitude, Instrumentation, Lakes, Surface tension, Water level fluctuations, Indicators, Turbulence, Turbulent flow, Diffusion.
Identifiers: Wave models.

On the basis of a Lake Baikal model of 100 sq m in area, the principle parameters of wind waves were recorded using several fans and wave recording devices. A critical review is given of the methods and instruments utilized in this model study to help select the best methods for recording wind-formed waves. (Gabriel-USGS)
W70-02233

INVESTIGATION OF A LINEAR MODEL TO DESCRIBE HYDROLOGIC PHENOMENON OF DRAINAGE BASINS,
Texas A and M Univ., College Station. Water Resources Inst.
Fred A. Schmer.
Available from the Clearinghouse as PB-188 289, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, Tech Report No 19, Dec 1969. 107 p, 8 tab, 27 fig, 58 ref, 2 append. OWRR Project A-008-TEX.

Descriptors: *Rainfall-runoff relationships, Hydrograph analysis, Surface runoff, Mathematical models, Hydrology, Watersheds, Unit hydrograph.

This investigation is concerned with the applicability of the linear convolution relationship for approximating the rainfall-runoff phenomenon for small drainage basins. A solution for the transfer function of the convolution relationship is obtained by employing discrete mathematics similar to the Wiener-Hopf equation. The solution is obtained, based on the restraints of the physical system by linear programming. In this investigation, the hydrologic system is analyzed as a truly linear system. Recorded rainfall intensity is the input of the system, and recorded runoff output. A major concern of the study involves the effects of antecedent moisture conditions on the transfer function. Two basins are used to test the model -- an urban basin located within the city limits of Bryan, Texas and a rural basin approximately three miles east of Bryan, Texas. Results are presented which substantiate the use of the proposed linear model as an approximation to the hydrologic system. Generalized transfer functions are developed for each basin and tested with independent events. Antecedent moisture conditions are shown to have a definite predictable effect on the transfer function, and rainfall events are classified with an antecedent moisture condition criteria in order to select the proper transfer function for the event.
W70-02238

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
Colorado State Univ., Fort Collins.
Vujica Yevjevich.
Water Resources Res, Vol 4, No 2, p 225-232, Apr 1968. 8 p.

Descriptors: *Hydrogeology, *Water resources, *Water resources development, *Water supply, Precipitation (Atmospheric), Probable maximum precipitation, Forecasting, Hydrologic aspects, Climatic data, Weather modification, Evaporation, Evaporation control, Stochastic processes, Permeability, Channel morphology, Hydraulics, Hydraulic engineering, Hydrology.
Identifiers: *Misconceptions in Hydrology, Deterministic concepts, Hidden periodicities, Evaporation supression.

Several misconceptions that have been introduced into hydrology have had adverse consequences on the science and on water-resources development. Persistent use of the concept of maximum precipitation and maximum probable precipitation, for which there is no physical proof, has discouraged research into the structure and probability of extreme events, and may have led to an unwarranted security concerning flood-control works. Attempts at long-range forecasts of water supply based entirely on meteorological processes have misdirected research and raised false expectations. A misconception that hydrologic processes are composed of a limited number of hidden periodicities has retarded the use of modern stochastic analyses of time series. Cloud-seeding to increase numbers of raindrops rather than their coalescence may have had a negative effect on precipitation in arid regions. Considering groundwater, instead of the aquifer, as a resource has stressed the technology of withdrawal at the expense of study of methods of recharge and has led

to much unplanned overdraft of groundwater. Use of descriptive instead of numerical variables has delayed the application of modern methods to planning the exploration of the groundwater environment. As a result of the neglect of the stochastic properties of porous mediums, fluid mechanics theory has not departed far from the original works of Darcy. (Carstea-USGS)
W70-02313

DESIGN STORM DETERMINATION IN SOUTH AFRICA,
University of the Witwatersrand Univ., Johannesburg (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 02B.
W70-02324

HYDROLOGICAL REGIONS OF NEW ZEALAND,
Ministry of Work, Wellington, (New Zealand). Water and Soil Div.
C. Toebes, and B. R. Palmer.
New Zeal Ministry of Works Misc Hydrol Publication No 4, 1969. 45 p, 24 ref, 1 append.

Descriptors: *Hydrologic data, *Rainfall-runoff relationships, *Surface-groundwater relationships, *Climates, *Classification, Mapping, Geomorphology, Geology, Soil classifications, Vegetation effects, Land use, Watersheds (Basins), International Hydrological Decade.
Identifiers: *New Zealand, *Hydrologic classification.

A detailed hydrological classification divides New Zealand into 90 regions on the basis of annual average precipitation, aquifer permeability, topography, and culture. Each region is described in detail and shown on an index map. (Knapp-USGS)
W70-02325

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
A. V. Rozhdestvensky.
Gosudarstvennyi Gidrologicheskii Institut, Leningrad, Sbornik Rabot po Gidrologii No. 7, p 49-59, 1967. 6 tab, 12 ref.

Descriptors: *Discharge (Water), *Runoff, *Mathematical models, *Stochastic processes, *Mathematical studies, Water level fluctuations, Frequency analysis, Hydrologic data, Probability.
Identifiers: *Irtysh River, Angara River, Shilka River, Amur River of Siberia, Neva River, Volga River, Irtysh Unzha River.

Assuming random and stochastic (time-dependent) distribution of hydrologic data, the series of river discharge data of gaging stations in European Russian (Volga, Neva, and Unzha Rivers) and Siberia (Angara, Amur, and Irtysh Rivers) were statistically analyzed using the standard statistical methods and the Poisson law of distribution. The discharge fluctuations of the rivers studied exhibit stochastic or time dependent properties. It is of interest to note that the investigations by Alekhin (1963) on the correlation functions of annual discharges of 11 rivers show the presence of quasi-periodic functions with periods of 7-8, 14-16, and 20 years. (Gabriel-USGS)
W70-02417

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
Moscow State Univ. (USSR).
V. A. Kovda, E. M. Samoilova, V. D. Vasilevskaya, and I. V. Yakushevskaya.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 4, p 293-301, 1968. 2 fig.

Descriptors: *Soil formation, *Geochemistry, *Weathering, *Alkaline soils, *Semiarid climates, Soil groups, Glacial soils, Glaciers, History, Alkaline water, Groundwater, Carbonates, Calcium carbonate, Gypsum, Soil chemical properties.
Identifiers: *Plains, *USSR, North America.

The authors discuss the soil formation history of the Russian Great Plain. The plain is hydro-accumulative, formed during and after the glacial period. Changes in soils that occur in the southerly direction are due to occurrence of geochemical streams of surface and groundwater. The Great Plain was raised following glacial melting and the hydromorphic soils were subjected to neo-eluvial development processes. As the area became more arid, the soil regime was replaced by xerophytic processes and leaching of soils. The steppe and semi-deserts to the south became areas of accumulation of calcium carbonate, sodium carbonate and sodium bicarbonate in the soils and groundwater. Relict alkaline soils as well as current alkalinization are found on the Dnieper-Donetz and Oka-Donetz lowlands. Increased evaporation in the south caused gypsum to concentrate and come out of solution. The authors believe that similar soil phenomena occur in old alluvial plains with similar histories, for example, the plains of North America. (Crouse-Arizona)
W70-02428

THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
J. T. Hutton.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 4, p 313-322, 1968. 6 tab, 11 ref.

Descriptors: *Soil-water-plant relationships, *Soil profiles, *Soil chemical properties, *Rain water, *Elements (Chemical), Arid climates, Soil water movement, Evaporation, Plants, Salts, Carbonates, Calcium, Magnesium compounds, Fluorine, Chemical analysis.
Identifiers: *Australia, Barium, Strontium.

Chemical analysis of rain water, soils, and plants were conducted in Victoria and South Australia to evaluate the cycle of soluble elements in soils. Near the ocean the composition of rain water is strongly influenced by ocean spray. In inland areas that are arid or that experience long periods of drought, dust from dried soil surfaces and plant particles is the main source of material in rain water. In areas of aridity or extensive drought, rapid evaporation causes soluble salts to collect on or near the soil surface. These chemicals are readily taken up by the vegetative cover. Less soluble salts such as the carbonates tend to accumulate deeper in the profile, barium near the bottom, and magnesium, calcium and strontium half way down. There was a marked horizon of fluorine in mid-profile. Distribution of the more soluble elements in a soil profile is thus controlled by rainfall and climatic factors such as evaporative potential. Where rainfall is insufficient to remove the soluble elements, definite distribution patterns can be found in the soil profile. (Crouse-Arizona)
W70-02431

2B. Precipitation

THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
For primary bibliographic entry see Field 07B.
W70-02056

A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 03B.
W70-02096

EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 07B.
W70-02102

PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
California Univ., Santa Barbara.
For primary bibliographic entry see Field 06B.
W70-02129

EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
Mississippi State Univ., State College; and Auburn Univ., Ala.
For primary bibliographic entry see Field 08B.
W70-02174

STOCHASTIC PROCESS OF PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
P. Todorovic, and V. Yevjevich.
Colo State Univ Hydrol Pap No 35, Sept 1969. 61 p, 41 fig, 9 tab, 12 ref, 3 append. Grant No GK-1661 and GK-11444. (Nat Sci Found).

Descriptors: *Stochastic processes, *Precipitation (Atmospheric), *Streamflow forecasting, *Precipitation intensity, Probability, Statistical models, Mathematical models, Storms, Time series analysis, Water yield, Hydrographs.
Identifiers: Stochastic hydrology.

The continuous process of precipitation intensities is investigated through the study of probability distributions of six descriptors: number of storms in an interval of time; number of storms producing a given amount of precipitation; lapse time between a reference time and the end of a storm; the total precipitation of n storms; the precipitation of nth storm; and the total precipitation in a time interval. The parameters of the number of storms per time unit, and of the inverse of the average yield per storm, are derived as periodic functions of time inside the year. The comparison of derived theoretical probability distributions and the observed frequency distributions for the four examples used in the study is good, considering the sampling errors. (Knapp-USGS)
W70-02298

DESIGN STORM DETERMINATION IN SOUTH AFRICA,
University of the Witwatersrand Univ., Johannesburg (South Africa). Dept. of Civil Engineering.
J. F. A. Wiederhold.
Witwatersrand Univ, Dep Civil Eng Hydrol Res Unit Rep No 1/69, 1969. 193 p, 56 fig, 37 tab, 36 ref, 6 append.

Descriptors: *Precipitation (Atmospheric), *Synoptic analysis, *Duration curves, *Design storm, Meteorology, Climatology, Depth-area-duration analysis, Rainfall-runoff relationships, Runoff forecasting, Streamflow forecasting, Hydrographs, Distribution patterns, Design flow, Water management (Applied), Mathematical models, Computer programs.
Identifiers: *South Africa.

In South Africa an attempt has been made to analyze extremes of precipitation and to provide information in a form suitable for hydrometeorological determination of the full range of design flood discharges. A single diagram depicts for the whole country (subdivided into summer-, winter-, and year-round-rainfall) depth-duration-frequency relationships for point rainfall of duration ranging from 1/4 hour to 24 hours. Techniques are developed for the fitting of high-degree polynomial

functions by computer to representations of storm rainfall to facilitate depth-area analyses. From depth-area analyses of 170 well-distributed major large-area storms experienced since 1932 in South Africa the country is subdivided into 29 meteorologically homogeneous subregions. Within each subregion available storm data are subjected to extreme value analysis to yield depth-area-duration-frequency relationships, and regional diagrams are presented. Estimates of precipitable moisture content of the atmosphere during each recorded storm provide an approach to probable maximum precipitation in the form of an upper envelope curve. The composite diagram for each subregion shows the isohyetal map of the most severe storm recorded (as a guide to shape and orientation of design storm), the depth-area-duration-frequency relationship and the PMP-area-duration graph. Details are given of the development of the surface-fitting procedures and of computer programs. (Knapp-USGS)
W70-02324

2C. Snow, Ice, and Frost

GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
Norwegian Water Resources and Electricity Board, Oslo. Glaciology Section.
Gunnar Ostrem, Olav Liestol, S. R. Ekman, Christian Nielsen, and Svein Tornas.
Norges Vassdrags-Og Elektrisitetsvesen, Oslo, Rapp No 5/69, Mar 1969. 149 p, 85 fig, 5 charts, 2 map, 16 ref.

Descriptors: *Glaciers, *Hydrologic budget, *Regimen, Glaciation, Ablation, Melting, Movement, Precipitation (Atmospheric), Water sources, Sediment load, Streamflow.
Identifiers: *Norway.

The glaciohydrological measurements made in Norway in 1968 are tabulated and analyzed. A total of 10 glaciers in southern Norway and 3 in northern Norway were measured. On 5 glaciers meteorological observations were made during the main part of the summer season. Mass balance measurement error is estimated to be 4-8%, or about 20 cm of water equivalent. In 1968 snow accumulation was as much as 140% of normal; snow depths of 6-9 m were measured. In southern Norway the summer was 0.5C higher than normal, while in the north summer was almost 2C lower than normal. Mass balances were highly variable in the south, but all the northern glaciers showed surpluses. Triangulation nets are used to measure movement of all the glaciers studied. Movement data are tabulated and shown by maps. Sediment transport was measured in 4 glacial streams and a lake. (Knapp-USGS)
W70-02084

SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
Alaska Univ., College. Arctic Environmental Engineering Lab.; and Alaska Univ., College. Inst. of Water Resources.
For primary bibliographic entry see Field 03A.
W70-02113

SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
Allied Research Associates, Inc., Concord, Mass.
For primary bibliographic entry see Field 07B.
W70-02314

SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Soils Bureau.
G. G. C. Claridge, and I. B. Campbell.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 4, p 541-549, 1968. 17 ref.

Descriptors: *Deserts, *Antarctic, *Cold regions, *Soil formation, *Soil investigations, Soil classifications, Semiarid climates, Climatic zones, Arid lands, Coasts.

Antarctica is characterized by cold and extreme aridity. Approximately two percent of this continent is free from permanent ice and snow cover--much of it in the New Zealand portion of the continent. Soil forming factors have begun to work on this area. The authors report a morphological study of three Antarctic soils. They are compared with soils of similar areas in Chile, the United States and Australia. The conclusion is that Antarctic soils bear a strong resemblance to desert and semiarid soils of other parts of the world with similar soil forming processes. Antarctic soils are described as typical of soils of cold deserts. (Crouse-Arizona)
W70-02437

2D. Evaporation and Transpiration

WATER USE BY SALTCEDAR WITH MANY FACTORS,
Geological Survey, Lubbock, Tex.
For primary bibliographic entry see Field 03B.
W70-02134

POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
Kansas State Univ., Manhattan.
E. L. Skidmore, H. S. Jacobs, and W. L. Powers.
Agron J, Vol 61, No 4, p 543-546, July-Aug 1969. 4 p, 6 fig, 1 tab, 19 ref.

Descriptors: Evaporation, *Evapotranspiration, *Winds, Wind velocity, Wind speed, Agronomy, Crops, Water requirements, Great Plains, Effects, Agriculture, Energy balance, Hydrology, Bibliographies, Soil science.
Identifiers: *Potential evapotranspiration, Hydrologic models, Effect, Net radiometer, Van Bavel method.

The contribution of wind to calculated potential evapotranspiration was investigated with applications for the climate of the Great Plains. A revised combination model proposed by van Bavel for computing instantaneous potential evapotranspiration was used. The model contains 2 terms that are expressions for the portions of potential evapotranspiration primarily caused by net radiation and wind. With ambient water vapor pressure 20 mb, temperature 30 deg C, wind 2, 4, and 6 m/sec at 2 m with a roughness length of 1 cm, the contribution of wind-dominant term to evaporation from a wet surface is 0.15, 0.30, and 0.45 mm/hr, respectively. At 10-mb vapor pressure and the same temperature, the corresponding evaporation rates are 0.22, 0.43, and 0.65 mm/hr. On representative and consecutive nonwindy and windy days at Manhattan, Kans (average daily windspeeds at 45 cm were 0.88 and 2.26 m/sec), the wind-dominant term contributed 33 and 113%, respectively, as much as the radiation-dominant term to the total calculated potential evapotranspiration. For these 2 days, the ratio of potential evapotranspiration to net radiation was 0.98 and 1.60. (USBR)
W70-02143

NOCTURNAL RADIATION LOSS ESTIMATES FOR A FOREST CANOPY,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
James D. Bergen.
USDA Forest Serv Res Note RM-155, 1969. 4 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Thermal radiation, *Nocturnal, Heat transfer, Mountain forests, Heat balance, Forestry, Topography, Temperature, Air temperature, Frost protection, Forests, Meteorology, Colorado.
Identifiers: *Radiation, *Thermal radiation.

Average nocturnal net radiation over a conifer canopy measured with a suspended radiometer was compared with that estimated from the black body emission at the average air temperature below the radiometer, and the sky radiation measured at some distance away. Values agreed within 20 percent for 5 nights; measured radiation averaged 9 percent higher than the estimate. No systematic variation was found with windspeed or humidity.
W70-02200

POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
Forest Service (USDA), Portland, Oreg. Pacific Northwest Forest and Range Experiment Station.
J. H. Patric, and Peter E. Black.
USDA Forest Serv Res Pap PNW-71, 1968. 28 p.

Descriptors: *Water balance, *Climatic data, *Evapotranspiration, *Rainfall-runoff relationships, *Climatic zones, Air temperature, Precipitation (Atmospheric), Moisture availability, Artic Ocean, Pacific Ocean, Consumptive use, Arid climates, Cold regions, Coniferous forests, Elevation, Humid climates, Tundra, *Alaska.
Identifiers: *Thornthwaite, Forest distribution.

Estimates and measurements of potential evapotranspiration (PET) by Thornthwaite's methods showed good agreement with estimates and measurements by other methods. Natural vegetation is closely related to climate. Vegetation distribution in the interior seems governed more by temperature than by moisture availability. The available data heavily bias classifications of climate to sea-level and valley-bottom conditions.
W70-02202

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
State Hydrological Inst. (USSR).
T. M. Gel'bukh.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 151-157, 1967. 7 p, 3 fig, 2 tab, 9 ref.

Descriptors: *Analytical techniques, *Mathematical studies, *Evaporation, *Water loss, *Reservoir evaporation, Hydrologic properties, Meteorological data, Water temperature, Humidity, Pressure, Wind velocity, Altitude, Heat flow, Air circulation, Turbulence, Frequency analysis.
Identifiers: *USSR, Evaporation basins, Kazakh SSR.

Evaporation from water surfaces was investigated by using the data from artificial basins of 20 sq m in area located in western Kazakhstan, USSR. The data were analyzed on the basis of an empirical formula giving the evaporation intensity as a function of wind velocity, two constants, and vapor pressure, or by using a theoretical function of airflow stability and turbulence. The dynamic factors (wind velocity, surface roughness) and thermal stratification of contiguous air can deviate considerably from the mean values based on long-term observations. As a result of these deviations the 2 constants are of variable character and the evaporation formula containing these constants is not generally useful. The theoretical aerodynamic formula, however, can be widely used because its parameters can be relatively easily calculated by taking into consideration the hydrometeorologic elements of the water basins. (Gabriel-USGS)
W70-02232

WATER EVAPORATION SUPPRESSION,
Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 03B.
W70-02276

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
Virginia Univ., Charlottesville.

For primary bibliographic entry see Field 03B.
W70-02277

HEAT AND MASS TRANSFER BETWEEN A WATER SURFACE AND THE ATMOSPHERE.
Tennessee Valley Authority, Norris. Div. of Water Control Planning.

TVA, Engineering Laboratory Report Revised, Aug 1968. 98 p, 44 ref.

Descriptors: *Heat transfer, *Mass transfer, Heat budget, Temperature, Evaporation, Heat balance, Solar radiation, Air temperature, Thermal conductivity, Latent heat, Enthalpy, Thermal radiation, Thermal pollution, Specific heat, Meteorology, Vapor pressure, Climatology.

Methods are reviewed and summarized for the computation of heat and mass transfer between a water surface and the atmosphere. The formulas presented are found in the technical literature and compared. The report deals with computation of all items of heat exchange, e.g., solar radiation, terrestrial long-wave radiation, evaporative and convective heat flux, etc. The summarized heat transfer terms can be used for the prediction of heat transfer in cases where only basic meteorological information is available. (Novotny-Vanderbilt)
W70-02401

2E. Streamflow and Runoff

VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02045

EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
Victoria State Rivers and Water Supply Commission (Australia).
For primary bibliographic entry see Field 02A.
W70-02046

FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-02053

CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
Walter R. Scott.
Geol Surv Open-file Rep, 1969. 31 p, 13 fig, 13 tab, 10 ref.

Descriptors: *Water resources, *Washington, Surface waters, Groundwater, Streamflow, Precipitation (Atmospheric), Water levels, Water quality, Water wells, Reservoirs, Recharge, Data collections, Hydrologic data, Discharge (Water).
Identifiers: *Colville River Basin (Wash), Stevens County (Wash).

Ample water is available in the Colville river basin, Washington, to meet present requirements and those of many years to come. The average runoff from the basin during the 42-year period 1923-64 was about 216,000 acre-ft. The runoff has been as low as 51,000 acre-ft in 1930 and as great as 390,000 acre-ft in 1951. Most of the runoff originates in the higher parts of the basin, where precipitation is greatest and occurs mostly as winter snowfall. Because of the storage effect of accumulated snowfall the annual peak discharge usually occurs during the last 10 days of April rather than during the periods of peak precipitation. Peak discharges are not extremely large; the maximum of the Colville River at Kettle Falls is 3,230 cfs (3.21 cu ft per sec sq mi). Low flows persist throughout much of July, August, and September, with minimum discharges generally occurring in August. Groundwater for domestic use can be obtained in sufficient quantitites from wells tapping unconsolidated deposits nearly everywhere in the basin. Yields as great as 1,700 gpm can be obtained from some individual wells. Generally, the chemical quality of both the surface and groundwaters in the basin is good. (Knapp-USGS)
W70-02060

TEMPERATURE ANALYSIS OF A STREAM,
Geological Survey, Tacoma, Wash.
M. R. Collings.
Geol Surv Res 1969, Prof Pap 650-B, p B174-B179, 1969. 6 p, 6 fig, 2 tab, 6 ref.

Descriptors: *Water temperature, *Streamflow, *Time series analysis, Regression analysis, Meteorology climates, Surveys, Fishkill, Irrigation water, Cooling water, Industrial water, Dissolved oxygen.
Identifiers: Harmonic analysis.

Temperatures of a stream were fitted and defined by a harmonic analysis of the probable occurrence, at the 95% level, of maximum and minimum monthly temperatures and of median temperatures throughout the year. The 0.5-probability curve of maximum temperatures was found to have equivalent values of amplitude and phase angle to that of a curve fitting 9 years of monthly maximum temperatures. Investigations also were made to determine the acceptability of using spot-temperature observations, by harmonic analysis, to obtain mean monthly temperatures throughout the year. A comparison, by regression analysis, of the mean monthly temperatures, from the thermograph record, with the synthetically determined median monthly temperatures, from the spot measurements, showed a standard error of 1.6 deg C. Another comparison, between the average harmonic curve from 4 years of spot measurements and the median curve from the maximum and minimum monthly temperatures, showed a standard error of 0.9 deg C. (Knapp-USGS)
W70-02062

DECADE REPRESENTATIVE AND EXPERIMENTAL RESEARCH BASINS IN THE UNITED STATES.
For primary bibliographic entry see Field 07A.
W70-02064

APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
Geological Survey, Washington, D.C.
P. H. Carrigan, Jr.
Geol Surv Res 1969, Prof Pap 650-B, p B162-B163, 1969. 2 p, 1 fig, 1 tab, 8 ref.

Descriptors: *Floods, *Statistical methods, *Time series analysis, *Probability, Discharge (Water), Streamflow, Flood forecasting, Base flow, Correlation analysis, Water storage.
Identifiers: *Poisson distribution.

The number of flood peaks per unit time (a year) above a selected base may be described by the Poisson distribution. The base magnitude must not be so low as to include carryover storage effects. A computer routine was developed to count the number of floods exceeding a selected discharge, to check the fit of the distribution, and to check for serial correlation. The Poisson distribution statistically describes the number of floods per unit time greater than a base, provided the base is of sufficient magnitude. Some rule of thumb for selection of the base, for example, an average of three peaks a year above base, may not ensure this sufficiency in base magnitude because the floods are affected by carryover storage. If a partial-duration series of flood discharges or flood stages is adequately described by the Poisson distribution, then there is no reason to reject the hypothesis that the number of floods per unit of time occur randomly in time. (Knapp-USGS)
W70-02078

REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
Geological Survey, Albuquerque, N. Mex.; Geological Survey, Anchorage, Alaska; and Geological Survey, San Juan, Puerto Rico.
For primary bibliographic entry see Field 07B.
W70-02080

FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-02085

FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
Corps of Engineers, Sacramento, Calif.
For primary bibliographic entry see Field 04A.
W70-02086

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-02087

FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
Corps of Engineers, St. Louis, Mo.
For primary bibliographic entry see Field 04A.
W70-02088

FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
Corps of Engineers, Fairbanks, Alaska.
For primary bibliographic entry see Field 04A.
W70-02089

ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
Ministry of Irrigation and Power, New Delhi (India).
For primary bibliographic entry see Field 04A.
W70-02111

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02114

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02115

DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
Geological Survey, Washington, D.C.
Alfonso Wilson, and Kathleen T. Iseri.
eol Surv Hydrol Invest Atlas HA-282, 2 sheet, 1969. 4 fig, 3 map, 7 tab, 6 ref.

Descriptors: *Discharge (Water), *Streamflow, *United States, *Puerto Rico, Surveys, Data collections, Gaging stations, Water balance, Hydrologic budget, Runoff, Water yield.
Identifiers: Discharge summary (U.S. Streams).

A 2-sheet hydrologic atlas quantifies the surface-water part of the discharge to the sea from the shores of the conterminous United States, Alaska, and Puerto Rico. It is a contribution to the UNESCO-sponsored project of the International Hydrological Decade, World Water Balance. The atlas is a preliminary step toward determination of the national water balance and of the continental water balance of North America. Computation of the water balance requires evaluation of that part of the hydrologic cycle that occurs at the air-land and air-water interfaces. In its simplest terms, the water balance may be expressed as the algebraic sum of the moisture inflow, outflow, and change in storage. Through long periods of time the net change in storage is negligible, and the water-balance equation becomes simply: Inflow= Outflow. Submarine discharge from the United States is believed to be small compared with surface runoff. Records from the gaging station farthest downstream in each basin were used to determine the gaged runoff. Surface streams discharge 1,746,000 cfs of water from an aggregate drainage area of 2,655,000 sq mi. This is equivalent to a runoff depth of 8.93 in. per year. (Knapp-USGS)
W70-02120

FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
Geological Survey, Washington, D.C.
Curtis H. Hannum.
Geol Surv Hydrol Invest Atlas HA-328, 1 sheet, 1969. 6 fig, 2 photo, 1 map, 4 ref.

Descriptors: *Floods, *Kentucky, Appalachian Mountain Region, Water levels, Stage-discharge relations, Hydrographs, Profiles, Mapping, Non-structural alternatives, Planning, Zoning, Regulation, Data collections, Hydrologic data, Forecasting.
Identifiers: Levisa Fork, Paintsville (Ky).

Hydrologic data are presented to be used to evaluate the extent, depth, and frequency of floods that affect the economic development of flood plains of the Levisa Fork and its tributaries at Paintsville, Kentucky. The data provide a technical basis for solving existing floodplain problems and formulating regulations for land use and development to reduce future flood damage. The areas flooded by 5-, 25-, and 50-year floods are shown on a topographic map. Flood boundaries were constructed from flood profiles based on field and historic data. (Knapp-USGS)
W70-02121

FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
Geological Survey, Washington, D.C.
George M. Farlekas.
Geol Surv Hydrol Invest Atlas HA-359, 1 sheet, 1969. 10 fig, 2 map, 2 tab.

Descriptors: *Floods, *New Jersey, Water levels, Stage-discharge relations, Hydrographs, Profiles, Mapping, Non-structural alternatives, Planning, Zoning, Regulation, Data collections, Hydrologic data, Forecasting.
Identifiers: Millstone River Basin, Hightstown (NJ).

Hydrologic data are presented to be used to evaluate the extent, depth, and frequency of floods that affect the economic development of flood plains of the Millstone River and its tributaries, Hightstown, New Jersey. The data provide a technical basis for solving existing floodplain problems and formulating regulations for land use and development to reduce future flood damages. The areas flooded by 5-, 25-, and 50-year floods are shown on a topographic map. Flood boundaries were constructed from flood profiles based on field and historic data. (Knapp-USGS)
W70-02122

FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
Geological Survey, Washington, D.C.
Stephen Hladio.
Geol Surv Hydrol Invest Atlas HA-350, 1 sheet, 1969. 3 fig, 1 map, 1 tab, 6 ref.

Descriptors: *Floods, *New York, Appalachian Mountain Region, Water levels, Stage-discharge relations, Hydrographs, Profiles, Mapping, Non-structural alternatives, Planning, Zoning, Regulation, Data collections, Hydrologic data, Forecasting.
Identifiers: Susquehanna River, Oneonta (NY).

Hydrologic data are presented to be used to evaluate the extent, depth, and frequency of floods that affect the economic development of flood plains of the Susquehanna River at Oneonta, New York. The data provide a technical basis for solving existing floodplain problems and formulating regulations for land use and development to reduce future flood damage. The areas flooded by 5-, 25-, and 50-year floods are shown on a topographic map. Flood boundaries were constructed from flood profiles based on field and historic data. (Knapp-USGS)
W70-02123

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
Hydrometeorological Service of the USSR, Moscow.
For primary bibliographic entry see Field 02A.
W70-02221

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02A.
W70-02223

METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
Voronezh State Univ. (SSSR).
For primary bibliographic entry see Field 02A.
W70-02224

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
Akademiya Nauk SSSR, Moscow. Institut Geografii.
For primary bibliographic entry see Field 02A.
W70-02225

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
All-Union Research Inst. of Water Supply, Drainage, Hydro-Engineering Works and Engineering Hydrogeology, Moscow (USSR).
Z. I. Petersen, and L. N. Popov.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst., Sbornik Rabot po Gidrologii, No 7, p 97-107, 1967. 11 p, 6 fig, 3 tab, 4 ref.

Descriptors: *Runoff, *Discharge (Water), *River basins, Geology, Climates, Precipitation (Atmospheric), Snow, Permafrost, Water level fluctuations, Vegetation, Forests, Hydrograph analysis, Evaporation, Air temperature, Dolomite, Limestones, Mathematical studies, Gaging stations.
Identifiers: *USSR, Angara River, Siberia.

The monthly and daily discharges of over 100 rivers of the Angara basin were analyzed on the basis of hydrologic data recorded at 99 gaging stations for several years. Geological, geographical, and hydrological studies show that the basin of 468,000 sq km in area is characterized by precipitation varying from 600 to 800 mm in the mountains, 350 to 400 m in the highlands, and by the presence of permafrost phenomena and karstic conditions in limestone and dolomite surface rocks. The results of the study are expressed by several maps and tables giving the distribution of minimum monthly and annual discharges in the Angara basin. (Gabriel-USGS)
W70-02226

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
William O. Maddaus, and Peter S. Eagleson.
Available from the Clearinghouse as PB-188 508, $3.00 in paper copy, $0.65 in microfiche. Mass Inst Technol Hydrodynamics Lab Rep No 115, June 1969. 134 p, 22 fig, 2 tab, 25 ref, append. OWRR Project No C-1069.

Descriptors: *Routing, *Rainfall-runoff relationships, *Mathematical models, *Computer programs, Flood routing, Hydrograph analysis, Simulation analysis, Model studies, Reservoirs, Overland flow, Streamflow, Linear programming, Optimization, Numerical analysis, Discharge (Water), Computer models, Streamflow forecasting.
Identifiers: *Kinematic wave analysis, Water shed models.

A distributed quasi-linear model of direct catchment runoff consists of cascades of linear reservoirs connected by linear channels. By fitting to the kinematic wave, the model parameters are expressed in terms of the physical characteristics of the catchment and the impulse response function is constrained to be input-dependent. Separate models of overland flow and streamflow are developed to facilitate consideration of spatially variable inputs. Investigation into the sensitivity of the catchment to distributed inputs illustrates the failure of the kinematic wave method to provide realistic hydrograph dispersion when applied to the flood-routing problem. (Knapp-USGS)
W70-02286

LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
For primary bibliographic entry see Field 08B.
W70-02287

WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
Geological Survey, Portland, Oreg.
F. J. Frank, and A. B. Harris.
Geol Surv Open-file Rep, 1969. 26 p, 4 fig, 4 tab, 7 ref.

Descriptors: *Water resources, *National parks, *Oregon, Water resources development, Recreation, Water wells, Springs, Aquifers, Water levels, Permeability, Infiltration, Data collections, Hydrologic data, Hydrogeology.
Identifiers: Crater Lake National Park.

Crater Lake National Park is on the crest of the Cascade Range in southwestern Oregon. The area is underlain by andesitic and basaltic lavas, pumiceous volcanic flow breccias, tuffs, and airborne and flow pumice. The pumice is an excellent medium for the infiltration of much of the 67 inches of annual precipitation. In many areas of the park, the occurrence of perched groundwater at altitudes below 6,500 ft is shown by numerous springs. Most of the streams and springs flow throughout the year. The quality of the water is excellent. During 1962, test drilling in the northern part of the park failed to locate perched-water bodies capable of

supplying quantities of water adequate for proposed facilities. The regional water table is below an altitude of 4,960 ft and wells at high altitudes may have to be drilled to depths exceeding 1,000 ft. The possibility of obtaining productive wells in the area is speculative. Springs are the source of water supply for present facilities. The most favorable areas for the development of ground and surface water are in the western, southern, and southeastern parts of the park. These areas have a well-defined surface-drainage system and have many springs and streams at altitudes below 6,500 ft which discharge quantities of water adequate for additional park facilities. (Knapp-USGS)
W70-02293

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA: PART 2, WATER RESOURCES,
Geological Survey, Huron, S. Dak.
For primary bibliographic entry see Field 02F.
W70-02306

HYDROLOGY ANNUAL NO. 14 - 1966.
Ministry of Works, Wellington (New Zealand).

Copies of rep avail from The Government Printer, Private Bag, Wellington, New Zeal. Cost-$3.00 (post free). Soil Conserv and Rivers Contr Counc Annu Hydrol Rep, 1968. 247 p, 5 fig, 19 ref.

Descriptors: *Data collections, *Hydrologic data, *Bibliographies, Streamflow, Stream gages, Snow surveys, Snow cover, Low flow, Floods, Discharge (Water), Recession curves, Sediment load, Suspended load, Water quality, Channel morphology, Stage-discharge relations.
Identifiers: *New Zealand.

Hydrologic data collected at 25 stations in New Zealand in 1966 are tabulated. Collected data include a list of streamflow stations, precipitation gages, sediment gages, water quality stations, snow courses, groundwater observation sites, representative and experimental basins, streamflow tables, snow survey data, recession curves, suspended sediment rating curves, water quality data, flood data, and channel morphology and efficiency surveys. An annotated bibliography of hydrological papers about New Zealand and by New Zealand authors is included. Addresses of all local hydrological and meteorological authorities and agencies collecting data are also included. (Knapp, USGS)
W70-02307

FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 04A.
W70-02312

BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
Geological Survey, Huron, S. Dak.
For primary bibliographic entry see Field 02F.
W70-02317

HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
Claiborne F. Galliher, and John E. Hull.
Geol Surv Open-file Rep, Sept 1969. 46 p, 31 fig, 5 tab, 8 ref.

Descriptors: *Data collections, Hydrologic data, *Florida, Surface waters, Groundwater, Streamflow, Water levels, Rainfall, Runoff, Recharge, Water management (Applied), Drainage, Irrigation, Canals.
Identifiers: *Dade County (Fla).

A quantitative picture of the general hydrologic conditions which prevailed in Dade County, Florida for the 1967 water year (October 1, 1966 to September 30, 1967) is summarized by use of tables, graphs, and maps. The location of groundwater stations and location of rainfall and surface-water stations are shown by a map. The water level, discharge and rainfall data were obtained from an extensive network of groundwater observation wells, stream-gaging stations, and rainfall stations. The records from long-term installations (1940 to present) are of special value because they allow analysis of the hydrologic effects of some water-control practices. (Knapp-USGS)
W70-02318

HYDROLOGICAL REGIONS OF NEW ZEALAND,
Ministry of Work, Wellington, (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 02A.
W70-02325

STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
Colorado State Univ., Fort Collins. Dept of Civil Engineering.
Andre J. Dumas, and Hubert J. Morel-Seytoux.
Colo State Univ Hydrol Pap No 34, Aug 1969. 29 p, 6 fig, 9 tab, 22 ref, 2 append. Contract No BR14-06-D-6597 (Bur of Reclam).

Descriptors: *Runoff forecasting, *Statistical methods, *Cloud seeding, Water resources development, Optimization, Sampling, Streamflow forecasting, Stochastic processes, Data processing, Routing.
Identifiers: Runoff change detection.

A technique was developed for rapid detection of suspected hydrologic change in high mountain watersheds. The method uses a sequence of independent daily flows. This procedure is superior to previous ones based on seasonal or yearly flows. The use of daily, instead of seasonal flow, data in a Student t-test reduces the number of necessary years of data for detection by an average of five in 14 out of the 20 cases studied, or by an average of three for the 20 cases. All of the cases come from the Upper Colorado River Basin. The study is particularly relevant to the planned cloud seeding operations of the Bureau of Reclamation in high elevation areas of the Colorado Rocky Moutains. The statistical procedure of detection relies on the Target Control concept and the application of a conditional Student t-test, a test of the difference between the adjusted means obtained by the regression lines between Target and Control for the seeded and non-seeded periods. (Knapp-USGS)
W70-02330

ON THE DIFFUSION OF HEATED JETS,
Royal Netherlands Meteorological Inst., De Bilt.
F. H. Schmidt.
Tellus, Quarterly Journal of Geophysics, Volume 9, No 3, p 378-383, Aug 1957. 2 fig, 8 ref.

Descriptors: *Jets, Temperature, Velocity, Distribution patterns, Flow profiles.

The propagation was studied of a heated jet in a stagnant environment in order to get a general solution without introducing any special assumptions about the velocity and temperature distributions in the jet. It was shown that Schmidt's and Tollmien's solutions are contained in the general one developed. A new cross-sectional velocity distribution was proposed, which seemed to be preferable above the generally accepted Gaussian distribution. In the development of the solution, no account has been taken of the fact that the similarity of velocity and temperature profiles only comes into being at distances of about ten times the diameter of the aperture from the orifice. It has been found that the flow in a free jet is a very complicated hydrodynamic phenomenon. (Guerrero-Vanderbilt)
W70-02402

HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
California Univ., Berkeley.
Nobuyuki Tamai, Robert L. Wiegel, and Gordon F. Tornberg.
Journal of the Power Division, Proceedings of ASCE, Vol 95, No PO2, p 253-276, Oct 1969. 12 fig, 1 tab, 23 ref.

Descriptors: *Jets, *Mixing, *Turbulent flow, *Cooling towers, Thermal powerplants, Thermal pollution, Heated water.

An attempt was made to: (1) present data from a number of sources on the cooling water capacities of thermal powerplants, together with the flow characteristics; (2) compare the results of a number of studies of the mixing of buoyant flows discharged horizontally at the surface of a body of water; and (3) present the results of new studies of such flows. Experiments were performed in a tank 25 feet long by 3 1/2 feet wide by 2 feet deep. A hot water heater was installed to provide the necessary hot water. The flow of the jet was measured by an orifice meter in the pipeline and controlled by a valve. Measurements were made using a commercially available multipoint strip chart recorder. The time between two successive measurements was 1.67 sec. Large thermal-electric powerplants use an average of 1.5 cfs per Mw cooling water, with a temperature rise of about 10 to 20 deg F and flow velocities with a mean of about 7 fps; the resulting densimetric Froude numbers range from 2.5 to 12.5. A review of laboratory studies and prototype measurements indicate that this is in the range of transition from jet mixing to surface spreading regimes, with the possibility of a third regime existing for the lowest densimetric Froude numbers. It appears that the mixing by turbulence in the receiving water of the prototype is of equal importance to the mixing by the turbulence within the prototype jet. (Guerrero-Vanderbilt)
W70-02412

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
A. N. Lyapin.
Gosudarstvennyi Gidrologicheskii Institut, Leningrad, Sbornik Rabot po Gidrologii No 7, p 141-145, 1967. 1 fig, 5 ref.

Descriptors: *Mathematical models, *Mathematical studies, *Streamflow, River flow, Currents (Water), Bottom sediments, Water circulation, Simulation analysis, Pressure, Energy, Turbulent flow, Friction, Froude number, Velocity, Energy dissipation.
Identifiers: *USSR, Streamflow models.

On the basis of modified standard differential equations of motion, the Froude number, and two non-dimensional mathematical criteria, a method was developed for analytical modeling of variable streamflows. The use of analytic modeling gives results comparable with those obtained from experimental observations, if the tangential accelerations of negative character are assumed to be constant and equal to their maximum values. Moreover, for practical utilization of this analytical modeling it is necessary to have the value of a coefficient K which reflects the value of pressure gradient. (Gabriel-USGS)
W70-02415

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02A.
W70-02417

2F. Groundwater

GROUNDWATER LEVELS IN THE UNITED STATES, 1962s66, NORTH-CENTRAL STATES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02044

NOTES ON THE GEOLOGY AND PALEOHYDROLOGY OF THE BOULDER CITY PLUTON, SOUTHERN NEVADA,
Geological Survey, Denver, Colo.
R. Ernest Anderson.
Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 Price $2.75. Geol Surv Res 1969, Prof Pap 650-B, p B35-B40, 1969. 6 p, 5 fig, 4 ref.

Descriptors: *Paleohydrology, *Nevada, Groundwater movement, Water chemistry, Igneous rocks, Iron oxides.
Identifiers: Boulder City Pluton (Nev).

The Boulder City pluton, a composite granitoid Tertiary intrusive mass exposed for more than 10 sq mi in the extreme northern Eldorado Mountains, Nevada-Arizona, is bounded mostly by faults. It locally intrudes Patsy Mine Volcanics, and is capped by Mount Davis Volcanics. On the basis of stratigraphic and isotopic data, the pluton has an age ranging from Eocene to Miocene. The pluton and adjacent rocks are crossed at an altitude of about 2,400 ft by a horizontal red-brown cliff-forming zone that was probably colored by deposition of ferric oxide from groundwater solutions as an ancient water table fluctuated over an interval of about 100 ft. Subsequent downcutting by the Colorado River has exposed the pluton to a depth of about 1,800 ft below this zone, and thus reveals that the pluton is probably not a laccolith or sill-like mass as has been previously suggested. (Knapp-USGS)
W70-02073

DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.; and Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 03B.
W70-02076

OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
Geological Survey, Trenton, N.J.; and New Jersey State Dept. of Conservation and Economic Development. Water Policy and Supply Div.
For primary bibliographic entry see Field 03B.
W70-02077

CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
Geological Survey, Columbus, Ohio.
For primary bibliographic entry see Field 07B.
W70-02079

EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, S. Dak.
For primary bibliographic entry see Field 03B.
W70-02081

GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
Geological Survey, Austin, Tex.
W. H. Alexander, Jr., and J. H. Patman.
Tex Water Develop Board Rep No 95, May 1969. 93 p, 14 fig, 5 tab, 48 ref.

Descriptors: *Water resources, *Groundwater, *Texas, Aquifers, Water wells, Water yield, Water levels, Water quality, Water supply, Water storage, Groundwater movement, Hydrologic data, Data collections, Hydrogeology.
Identifiers: Kimble County (Tex), Edwards Limestone.

The aquifer formed by the Edwards and associated limestones, which underlies all of the upland areas in Kimble County, Texas is the most extensive source of fresh groundwater in the county. In addition to the flow of springs, this aquifer supplied an estimated 420 acre-feet in 1964. The theoretical quantity available for future development from this aquifer in Kimble County is about 33,000 acre-feet per year. The alluvial deposits along the major streams, although relatively small in capacity to store water, supply more than half of the fresh water pumped from wells in Kimble County--about 1,200 acre-feet of the total 1,900 acre-feet in 1964. This aquifer supplies annually about 1,000 acre-feet to the city of Junction and most of the 210 acre-feet pumped for irrigation. The total quantity of water available for future development from all of the alluvial deposits is closely related to the minimum base flow of the Llano River. The minimum base flow was 10 mgd during the summer period (April through September) of 1955, which is several times the present use. The other aquifers in the county yield a total of about 30 acre-feet of fresh water per year. (Knapp-USGS)
W70-02091

VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 06B.
W70-02110

WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
State Hydrological Inst., Leningrad (USSR).
For primary bibliographic entry see Field 02A.
W70-02219

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
Institut po Proektirovaniiu Predpriiatii Nikelevoi Promyshlennosti, Leningrad (USSR).
For primary bibliographic entry see Field 02A.
W70-02220

FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
Clemson Univ., S.C. Water Resources Research Inst.
For primary bibliographic entry see Field 07B.
W70-02241

ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
Purdue Univ., Lafayette, Ind. Dept. of Geosciences.
L. G. Davis, A. K. Turner, and W. N. Melhorn.
PB-188 510. Purdue Univ Water Resources Res Center Tech Rep No 3, June 1969. 83 p, 33 fig, 5 tab, 46 ref, 2 append. OWRR Proj No A-006-IND.

Descriptors: *Water level fluctuations, *Indiana, *Statistical methods, *Analog models, Groundwater movement, Recharge, Discharge (Water), Water levels, Correlation analysis, Data collections, Water table.
Identifiers: Trend surface analysis, Bartholomew County (Ind).

A 50-sq mi section of unconfined aquifer in glacial outwash in Bartholomew County, Indiana was studied by trend surface techniques while the U.S. Geological Survey performed an analog model study. Detailed information on geologic conditions, recharge, discharge rates, and water levels measured for 13 consecutive months at 30 observation wells was used. Fourth-degree trend surfaces were the most complex that could be fitted to the data because of clustering of some wells. Computer-generated trend and residual maps were produced. Map comparisons utilized 'cross-correlation' procedures. The water-table geometry went through a cyclic change reflecting seasonal changes in recharge and discharge rates. Map comparison procedures suggest the groundwater regime reacts to such changes with a delay of less than one month. Graphical and statistical procedures are important in evaluating the significance of any trend surface. Under favorable conditions trend surfaces can help identify influent and effluent streams, and the influence of buried drainage patterns on the groundwater flow. The results of trend analysis closely agree with results obtained by analog models. (Knapp-USGS)
W70-02288

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
For primary bibliographic entry see Field 03A.
W70-02290

WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
Geological Survey, Portland, Oreg.
For primary bibliographic entry see Field 02E.
W70-02293

GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
Illinois State Water Survey, Urbana.
Adrian P. Visocky, and Richard J. Schicht.
Ill State Water Surv Rep Invest No 62, 1969. 52 p, 37 fig, 22 tab, 40 ref.

Descriptors: *Aquifers, *Glacial drift, *Valleys, *Illinois, Water resources, Groundwater, Hydrogeology, Hydrologic data, Data collections, Water wells, Water yield, Permeability, Transmissivity, Water quality, Water resources development, Model studies, Analog models, Recharge.
Identifiers: *Mahomet buried valley (Ill).

The buried Mahomet Bedrock Valley and its major tributaries cover about 3700 square miles in east-central Illinois, and form a large underdeveloped groundwater resource. The largest source of groundwater consists of Kansan sands and gravels, called the deep aquifer; the Illinoian or middle aquifer is a secondary source. Pumpage was 40.2 mgd in 1965. Major pumping centers are at Champaign-Urbana, Rantoul, Lincoln, Taylorville and Hoopeston; the largest is Champaign-Urbana with pumpage of 13.5 mgd in 1965. Recharge in the Champaign-Urbana area was computed to be 115,000 gpd/sq mi for the Illinoian aquifer in 1947 and 107,000 gpd/sq mi for the Kansan aquifer during 1953-1965. Total groundwater runoff for the valley is estimated to be about 740/mgd during years of normal precipitation. Existing and/or future pumping centers might capture 445 mgd. An electric analog computer was constructed for the Champaign-Urbana area. Withdrawals with a selected pumping scheme would total 30.3 mgd from existing large capacity wells and 15 mgd from 5 future wells. This study provides data for planning and development of area groundwater resources. (Knapp-USGS)
W70-02305

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA: PART 2, WATER RESOURCES,
Geological Survey, Huron, S. Dak.
Lewis W. Howells, and Jerry C. Stephens.

Available, no charge, from South Dakota Geol Survey, Science Center, South Dakota University, Vermillion. S Dak Geol Surv Bull No 18, 1968. 65 p, 11 fig, 2 plate, 8 tab, 43 ref, 3 append.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Surveys, *South Dakota, Streamflow, Water supply, Water wells, Water yield, Water quality, Hydrologic data, Data collections, Hydrogeology.
Identifiers: Beadle County (S Dak).

The surface-water resources of Beadle County, S. Dak. are relatively undeveloped. During 1963, except for about 1,800 acre-ft diverted for irrigation, 2,785 acre-ft diverted for municipal and industrial uses, and small diversions for stock supplies, most of the flow was unused. Average net runoff from the surface of the county is more than 25,000 acre-ft per year. Most of the 1.2 million acre-ft of precipitation in an average year is lost as evapotranspiration. More than 5 million acre-ft of water is stored in 3 aquifers in surficial deposits. About 3,200 acre-ft was pumped from about 700 wells in 1963 for irrigation, stock, domestic, and municipal supplies. Two artesian aquifers in bedrock strata are major sources of water for stock, domestic, and municipal use. The aquifer in the Niobrara Marl and Codell Sandstone Member of the Carlile Shale supplies soft water to about 140 wells in the east-central third of the country. The aquifer in the Dakota Formation supplies water to more than 1,060 wells (most of which flow) throughout the county. (Knapp-USGS)
W70-02306

HYDROLOGY ANNUAL NO. 14 - 1966.
Ministry of Works, Wellington (New Zealand).
For primary bibliographic entry see Field 02E.
W70-02307

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
Nova Scotia Dept. of Mines, Halifax. Groundwater Section.
Peter C. Trescott.
Nova Scotia Dep Mines Mem 6, 1968. 159 p, 50 fig, 2 map, 21 tab, 80 ref, 6 append.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Surveys, Data collections, Hydrologic data, Mapping, Water yield, Water quality, Water wells, Recharge, Gravels, Glacial drift, Water levels, Water table, Water supply.
Identifiers: *Canada, *Nova Scotia, Annapolis-Cornwallis Valley, Aquifer testing.

The largest resource of fresh water in the Annapolis-Cornwallis Valley, Nova Scotia is stored in the ground. Major aquifers are present in the Triassic bedrock and in the overlying surficial deposits. The most extensive aquifers are the Triassic Wolfville sandstones and conglomerates, which underlie the entire Valley. It is often possible to construct wells in these aquifers which will yield several hundred gpm. The most important local aquifers, however, are the glacial sand and gravel deposits which are found mostly in the eastern and central parts of the Valley. A well has been constructed in one of these aquifers which will yield over one thousand gpm. The surficial deposits and pertinent bedrock boundaries in the Valley have been mapped at a scale of 1 inch to 1 mile. A second map was made of the bedrock hydrostratigraphic units, the saturated thickness of sand and gravel, and the depth to the water table. Information on the hydraulic properties of the aquifers was obtained with pump tests. With the information available, a hydrologic budget was calculated. Of 42 inches of precipitation in this basin during a 'normal' year, about 53% is discharged as storm and snowmelt runoff, 17% as groundwater runoff, and 30% as evapotranspiration. (Knapp-USGS)
W70-02309

BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
Geological Survey, Huron, S. Dak.
Michael J. Ellis, and Donald G. Adolphson.
Available, no charge, from South Dakota Geol Survey, Science Center, South Dakota University, Vermillion. S Dak Geol Surv - S Dak Water Resources Comm Water Resources Rep No 5, 1969. 124 p, 6 fig, 12 ref, 1 append.

Descriptors: *Hydrologic data, *Data collections, Water wells, Water levels, Observation wells, Streamflow, Water quality, Surface waters, Groundwater.
Identifiers: Big Sioux River basin (S Dak).

Basic groundwater and surface data are compiled for the Big Sioux River Basin, eastern South Dakota. Tabulated data include logs of test holes and observation wells, water levels in observation wells, aquifer properties, streamflow records, and water chemical analyses. (Gabriel-USGS)
W70-02317

HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 02E.
W70-02318

HYDROLOGICAL REGIONS OF NEW ZEALAND,
Ministry of Work, Wellington, (New Zealand). Water and Soil Div.
For primary bibliographic entry see Field 02A.
W70-02325

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
Michigan State Univ., East Lansing. Dept. of Geology.
For primary bibliographic entry see Field 02K.
W70-02328

2G. Water in Soils

AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
Soil Conservation Service, Beltsville, Md.
For primary bibliographic entry see Field 07C.
W70-02066

SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
Geological Survey, Tacoma, Wash.
M. R. Collings.
Geol Surv Res 1969, Prof Pap 650-B, p B194-B198, 1969. 5 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Soil moisture, *Rainfall-runoff relationships, *Water loss, *Evapotranspiration, *Antecedent precipitation, Drying, Hydrologic budget, Evaporation, Water yield, Infiltration, Sampling, Regression analysis.
Identifiers: *Antecedent moisture.

Samples of the upper 3 inches of soil were collected on two small study areas in east-central Arizona for 2 years during the period of summer rainfall to define a relation for predicting antecedent soil-moisture conditions. The data of available moisture versus time were found to fit an exponential regression. The regressions have 0.03-inch and 0.04-inch standard errors of estimate. Antecedent soil moisture, in the upper 3 inches, may be predicted with 0.065-inch and 0.109-inch standard errors of estimate. (Knapp-USGS)
W70-02083

SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 04A.
W70-02095

MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
Rothamsted Experimental Station, Harpenden (England).
For primary bibliographic entry see Field 07B.
W70-02124

THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS: IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
National Vegetable Research Station, Wellesbourne (England).
P. J. Salter, and J. B. Williams.
J Soil Sci, Vol 18, No 1, p 174-181, Mar 1967. 8 p, 2 fig, 1 tab, 11 ref.

Descriptors: *Soil moisture, *Moisture availability, *Soil texture, Soil horizons, Soil profiles, Water utilization, Particle size, Soil types, Water storage, Field capacity.
Identifiers: *Available soil water capacity, Textural classes.

The available-water capacity (AWC) of soil profiles in the field may be estimated by (a) measuring the thickness of each soil horizon; (b) assessing its texture; and (c) summing the products of the thickness of each horizon and the mean values of AWC for the relevant textural classes. This mean value of AWC was calculated from the average particle-size composition and from a relationship between particle size composition and AWC. Estimates of AWC using this method were compared with measured values for each of 39 soils. When a 21 textural-class system was used to describe the soils, the mean error (the error of the estimated AWC value relative to the measured value) was 10% and with a 12 class system the mean error was 17%. (Carstea-USGS)
W70-02125

INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
Department of Agriculture, Lethbridge (Alberta). Research Station.
J. C. Van Schaik.
J Soil Sci, Vol 18, No 1, p 42-46, Mar 1967. 5 p, 2 fig, 1 tab, 8 ref.

Descriptors: *Permeability, *Sodium, *Gypsum, *Glacial soils, Soil water movement, Till, Montmorillonite, Clay minerals, Ion exchange, Particle size, Clays.
Identifiers: *Exchangeable sodium percentage, Adsorbed sodium.

The permeability of glacial till soils having mainly montmorillonite in the clay fraction was negligible when the exchangeable sodium percentage (ESP) exceeded 15 to 20. Relatively higher permeability values were obtained in soils containing gypsum, but water tramsmission through such soils was negligible above ESP of 30 to 35. The relative decrease in permeability with increase in exchangeable sodium depends not only on the ESP and electrolyte concentration in the soil solution but is affected by the types of clay minerals. (Carstea-USGS)
W70-02126

FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
Idaho Univ., Moscow.
For primary bibliographic entry see Field 04B.
W70-02154

SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
Forest Service (USDA), Portland Oreg. Pacific Northwest Forest and Range Experiment Station.
J. H. Patric, and F. R. Stephens.
Soil Science, 106 (3): p 172-176, 1968.

Descriptors: *Evapotranspiration, *Moisture availability, *Moisture content, *Tension, Bulk density, Porosity, Sub-arctic, Forest soils, Glacial soils, Organic soils, Soil moisture, Moisture uptake, Rainfall, Consumptive use, *Alaska.
Identifiers: Sub-arctic soils, Sub-arctic vegetation, Penman.

Moisture content of forest soils near Juneau, Alaska, was measured with tensiometers during the 1966 growing season. Tension never exceeded 0.25 atmosphere except on a very shallow soil (0.60 atmosphere) and in a bed of annual flowering plants (0.73 atmosphere) subject to advective energy. Daily soil-moisture loss agreed closely with evaporative loss. Soil-moisture losses were almost identical on clearcut and nearby forested soil of the same type and suggest that forests in southeast Alaska rarely, if ever, experience damaging soil-moisture deficits.
W70-02201

EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
South Dakota State Univ., Brookings.
For primary bibliographic entry see Field 03C.
W70-02280

A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
N. I. Il'in, and Ye S. Dzektser.
Gosudarstvennyi Gidrologicheskii Institut, Leningrad, Sbornik Rabot po Gidrologii No 7, p 166-169, 1967. 2 fig, 1 tab, 4 ref.

Descriptors: *Groundwater movement, *Water circulation, *Peat, *Bogs, *Tracers, Tracking techniques, Radiochemical analysis, Radioactivity techniques, Indicators, Boreholes, Soils, Water analysis, Discharge (Water), Sands, Pressure, Frequency analysis, Drainage patterns (Geologic), Statistics.
Identifiers: *USSR, Gorki region, Peat bogs.

On the basis of a formula giving groundwater discharge as a function of initial and successive concentrations of an indicator in a borehole and the borehole dimensions, water circulation in peat bogs in the Gorki region of European USSR was investigated. A method of radioactive indicator dilution, using a single borehole, can be used for reliable determination of the thickness of water-bearing peat layers and their water circulation. However, this method does not localize in depth the layers characterized by anomalous water circulation and therefore, can be used only as a tool of preliminary exploration. (Gabriel-USGS)
W70-02416

AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
Leningrad State Univ. (USSR).
A. F. Tsyganenko.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 4, p 333-341, 1968. 18 ref.

Descriptors: *Soil chemical properties, *Geochemistry, *Weathering, *Soil formation, *Migration, Salt balance, Salts, Rain water, Pollutants, Soil contamination, Ion exchange, Precipitation (Atmospheric).
Identifiers: *USSR, Aeolian migration.

Notice is taken of the recent availability of data indicating substantial amounts of atmospheric pollutants entering the soil. This paper reviews literature on this subject and discusses implications regarding geochemical and soil forming processes and the salt balance on the land. Only in mountain areas or areas of widely spread salt bearing rocks does ionic runoff in rivers exceed ion income from the atmosphere to river basins. Principle sources of salts are ancient accumulations in sedimentary deposits and continental reservoirs as well as the ocean. These sources are found more important than modern processes of rock decay. Aeolian migration of salts from arid zones as well as the ocean is contrary to some extent to the normal concept of movement of salts by river flow from land to ocean. Pedology should take into consideration the chemical content of rain water in soil formation and chemistry. The literature cited and the discussion are confined mainly to areas in the USSR. (Crouse-Arizona)
W70-02421

A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
Arizona Agricultural Experiment Station, Tucson; and Arizona Univ., Tucson. Dept. of Watershed Management.
Malcolm J. Swolinski.
Progressive Agriculture in Arizona, Vol 21, No 3, p 8-9, May-June 1969. 2 p, 2 fig, 7 ref.

Descriptors: *Rainfall simulators, *Infiltrometers, *Infiltration, *Research equipment, *Semiarid climates, Arizona, Soil water, Simulated rainfall, Watershed management, Instrumentation.
Identifiers: *Head tanks.

Hydrologic performance of a watershed is dependent upon the ability of its soils to absorb and transmit water. In development of watershed management programs, it is important to know infiltration characteristics of soils. This information is frequently obtained through application of artificial rainfall to infiltrometer plots established on the soils being studied. Successful measurement requires application of simulated rain at a predetermined rate and with constant distribution over the plot. The author reports development and design details of an apparatus designed to meet these requirements. Instrumentation was developed and used for infiltration studies in semiarid forest lands of northeastern Arizona to assist in developing watershed management plans concerned with flood and erosion control as well as water production in Arizona watersheds. (Crouse-Arizona)
W70-02422

THE SOILS OF THE TRUCIAL STATES: CLASSIFICATION AND CAPABILITY,
Durham Univ. (England). Dept. of Geography.
J. H. Stevens.
International Congress of Soil Science, 9th, Adelaide, Australia, Vol 4, p 253-260, 1968. 3 fig, 6 ref.

Descriptors: *Arable lands, *Arid lands, *Soil properties, *Land classification, *Soil classifications, Land reclamation, Surveys, Soil surveys, Soil physical properties, Soil chemical properties, Soil types, Soil investigations, Sierozems, Soil horizons, Saline soils, Alkaline soils.
Identifiers: *Arabian Peninsula, *Land capability, Trucial States.

The Trucial States, located on the arid Arabian Peninsula, are made up of five major physiographic regions. The southern part of the Oman Hills is formed of metamorphic and basic igneous rocks. To the west are the Central Gravel Plains formed by outwash from the hills. The author reports the results of a soil survey of the Gravel Plains conducted as a part of a water resources survey. The soils range from saline-alkali soils to sierozems and nonsaline-alkali soils and are subdivided on the basis of texture, calcium carbonate content, and depth of gravel horizons. Their properties are discussed in this contribution. The aim of the survey was to evaluate areas which could profitably be used for irrigated agriculture. Assuming availability of adequate water, soil qualities, particularly the presence of gravel horizons, are the limiting factors. The area is divided into land capability classes. The soils with gravel phases are assigned to the lowest capability classes. The heavy textured sierozems with a carbonate content of 25 - 50% are always classified as suitable for arable development. (Crouse-Arizona)
W70-02423

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
F. Penman.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol I, p 415-423, 1968. 3 tab, 24 ref.

Descriptors: *Salinity, *Arid lands, *Soil chemical properties, *Irrigation practices, *Drainage systems, Soil-water-plant relationships, Soils, Evaporation, Irrigation effects, Boron, Iron compounds, Iron, Leaching, Salts, Saturated soils, Irrigated land, Alkaline soils.
Identifiers: *Australia, Zinc.

There are extensive areas of Mallee land (solonized brown soils) in southeastern Australia. Some of this soil lying close to the River Murray is irrigated. Rainfall averages 10 to 13 inches annually with a yearly evaporative potential of 60 inches from a free water surface. The soil is typically alkaline with pH values up to 10 or above. Under irrigation these soils are subject to waterlogging and salinity with high boron concentrations occurring in some areas. Availability of zinc and iron is depressed in saline-sodic soils. Waterlogging and salinity have been successfully alleviated by artificial underdrainage, but leaching of boron is a slow process. Zinc compounds are applied in orchards and vineyards. Iron deficiency chlorosis is successfully controlled by the use of chelated iron. There is still a problem in irrigation practices of overloading the drainage systems. Sprinkler irrigation is recommended since it allows better control of the volume and distribution of irrigation water. Where furrow irrigation is still used, shortened lengths of irrigation runs are recommended. (Crouse-Arizona)
W70-02425

THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
J. J. Oertli.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 95-107, 1968. 1 tab, 6 fig, 18 ref.

Descriptors: *Soil-water-plant relationships, *Soil water movement, *Saline soils, *Plant physiology, *Plant growth, Soil chemical properties, Salinity, Arid lands, Turgidity, Moisture stress, Osmotic pressure, Barley, Corn (Field), Equations, Salts, Leaves.
Identifiers: *Water potential, *Salt transport.

Salinity in soil water frequently occurs under arid conditions. Presence of solutes in soil water at the root surface affects plant behavior. These solutes can be taken up into plant tissues and changes in osmotic pressures in the leaf sap occur which eventually bring an apparent adjustment in plant-water relations to external osmotic moisture stress. Nevertheless, a reduction in plant growth occurs under saline conditions. This paper is intended to aid in the interpretation of the water potential at the root surface, with the help of a plant model restricted to those aspects which seem particularly important. The author presents a theoretical discussion of effects of water potential and turgor pressure on cell elongation and discusses vacuolar

and extracellular solute relationships. Supporting experimental evidence from corn and barley seedlings is presented. It is evident that the adjustment of turgor pressure in the elongating cell takes more time under saline conditions because of the characteristics of salt transport. Salt burns may be the result of extracellular salt accumulations. Plant growth response to saline soil water can only partially be explained by the energy status of the external water. Static and dynamic aspects of both intra- and extracellular solutes must also be considered. (Crouse-Arizona)
W70-02426

PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Dept. of Soils.
K. E. Lee, and T. G. Wood.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 3, p 11-18, 1968. 3 tab, 16 ref.

Descriptors: *Soil chemical properties, *Organic matter, *Forest soils, *Semiarid climates, *Cellulose, Nitrogen, Soils, Wood wastes, Soil horizons, Biochemistry.
Identifiers: *Australia, *Termites, *Cycling.

Organic matter is usually relatively low in soils of arid and semiarid regions. The authors report a study made on the role of termites in incorporation and cycling of organic material in a semiarid woodland in southern Australia. Nasutitermes exitiosus (Hill) is a mound building species, common throughout southern Australia, which eats dead wood and incorporates its excretory products into its mounds and subterranean galleries. 311 kg/ha of organic material were found in termite mounds in the area studied. These mounds are occupied for as long as 50 years and remain for many more after abandonment. Thus, it was found that a quantitatively significant proportion of the total organic matter of the ecosystem was affected by termites. This differs from the situation in soils in other areas where activities of soil animals tend toward rapid incorporation of dead organic material in the upper soil horizons. (Crouse-Arizona)
W70-02427

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
Agricultural Radioisotope Lab. (Iraq); and Alexandria Univ. (Egypt).
A. Kadow, Fathi Amer, and L. Kadri.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 721-729, 1968. 2 tab, 2 fig, 12 ref.

Descriptors: *Arid lands, *Salinity, *Groundwater, *Cation exchange, *Soil chemical properties, Arable land, Irrigation water, Soils, Soil water movement, Alkalinity, Chlorine, Sodium, Bicarbonates, Calcium, Magnesium, Calcium carbonate, Salts.
Identifiers: *Iraq.

Most land in central and southern Iraq is submarginal for cultivation owing to high salinity. The authors report a study of the dynamics of salinity in four different Iraqi soil profiles where salt accumulation was due to capillary rise from groundwater or accumulation from irrigation water. In making the analyses it was assumed that the entire Cl content of groundwater remained in the soil solution. It was found that about 90% of the variance in ESR (exchangeable sodium ratio) could be accounted for by variance in SAR (sodium adsorption ratio) when the effects of the anion species were considered separately. SAR was found to increase as the sample sites moved toward the south. Na in the capillary stream caused a partial replacement of exchangeable Ca and Mg. The differential translocation of Mg as soluble Mg (HCO sub 3)sub 2 was increased by presence of HCO sub 3 super - and favored inactivation of Ca as CaCO sub 3. The Gapon constant for the exchange equilibrium between Ca and Mg was generally greater than unity, but did vary for the different soils. (Crouse-Arizona)
W70-02430

THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
For primary bibliographic entry see Field 02A.
W70-02431

SALTING IN IRRIGATION AREAS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Soils.
G. N. Evans.
Chiasma, Armidale, No 6, p 113-115, 1968. 2 fig.

Descriptors: *Arid lands, *Salinity, *Groundwater, *Irrigated land, *Drainage, Saline soils, Groundwater movement, Hydrology, Evapotranspiration, Irrigation practices, Saline water, Salts, Evaporation, Damages, Water table.
Identifiers: *Australia, *New South Wales.

Throughout the history of irrigated agriculture many arable acres have been put out of production by salinity. This is especially true in arid areas of the ancient world. As agriculture now moves into more arid lands, such as interior southern Australia, it is increasingly important that the possibility of salting damage be assessed and avoided through careful planning and management. The author reviews processes by which salinity occurs and sources of salts. These are developed with examples from the Hawkesbury River Flats in New South Wales, Australia. The author concludes that salting problems can be avoided by careful selection of suitable irrigation sites, irrigation management and good drainage. (Crouse-Arizona)
W70-02433

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
V. V. Egorov.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 437-441, 1968.

Descriptors: *Salinity, *Drainage, *Drainage systems, *Arid lands, *Soil physical properties, Groundwater, Groundwater movement, Permeability, Water table, Soil chemical properties, Reclamation, Drainage density, Soil structure, Evaporation, Geomorphology, Saline soils, Salts, Hydrogeology, Irrigation effects, Leaching.
Identifiers: *USSR, *Piedmont plains.

The USSR has vast arid lands that can be used for agriculture only with irrigation. Despite years of experience, development of new lands and sometimes use of older irrigated lands are hindered by salinization of the soils. The author discusses the particular problems inherent in developing new lands in the piedmont plains of Middle Asia and eastern Transcaucasia. Methods of salinity control developed for older areas cannot always be transferred to the piedmont because structure of the piedmont plains is more complex than previously presumed. At the end of each concealed step of the piedmont there are textural changes which impede subsurface flow of water. Thus, inadequate drainage and secondary pressure result, retarding the leaching of soil salts. Vertical drains are recommended to reduce or eliminate groundwater pressure. Because of low permeability of soils on deluvial trains of the piedmont plains, horizontal drains are needed for removal of salt solutions and for lowering the groundwater table. Spacing should vary according to severity of the salinity problem and structural peculiarities of the particular area. (Crouse-Arizona)
W70-02434

SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
Department of Scientific and Industrial Research, Wellington (New Zealand). Soils Bureau.
For primary bibliographic entry see Field 02C.
W70-02437

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
V. M. Borovskiy.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 473-481, 1968. 19 ref.

Descriptors: *Salinity, *Evaporation, *Drainage, *Irrigated land, *Groundwater, Saline water, Salt balance, Soil chemical properties, Soils, Capillary action, Irrigation practices, Salts, Saline soils, Soil physical properties, Arid lands, Deserts, Hydrologic properties.
Identifiers: *USSR, *Turan Plain.

Over 60% of irrigated lands in the USSR are located on the Turan Plain of Central Asia and South Kazakhstan. The area produces over 90% of the cotton in the USSR as well as other crops. 75% of the soils are subject to secondary salinization. This is not true of the remaining area which has naturally adequate drainage. Careful regulation of the water-salt system through well planned irrigation practices is essential to preventing destruction of arable land by salinization. The main source of these salts is from groundwater. In developing proper irrigation practices for each area, consideration must be given to hydrologic properties of the entire profile from surface to groundwater table, nature of the soils, terrain, and nature of the groundwater. The author presents a general discussion of physical and chemical characteristics which cause a real danger of secondary salinization of the Turan Plain unless adequate precautions are taken. (Crouse-Arizona)
W70-02439

WATER REPELLENT SANDS,
Commonwealth Scientific and Industrial Research Organization, Adelaide (Australia). Div. of Soils.
R. D. Bond.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 339-347, 1968. 4 fig, 11 ref.

Descriptors: *Impervious soils, *Infiltration, *Sands, *Wettability, *Pastures, Soil physical properties, Germination, Plant growth, Soil-water-plant relationships, Soils, Organic compounds, Arid lands, Capillary action, Semiarid climates, Soil moisture.
Identifiers: *Australia, Contact angle.

This paper reports field investigations of water repellent sandy soils in South Australia. In arid or semiarid lands where soil moisture for plant growth is already limited by the climate, soils of a water repellent nature cause further difficulties in even infiltration of the limited rainfall and subsequent uneven germination and poor growth of range and pasture grasses. Water repellence is caused by organic coatings which prevent water films from spreading over soil particles since the advancing contact angle of wetting with water is frequently greater than 90 degrees. Observations showed that the degree of water repellence varied with type and age of plant cover. (Crouse-Arizona)
W70-02440

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
All-Union Scientific-Research Inst. of Hydrotechnics and Reclamation, Moscow (USSR).
V. E. Bobchenko, and A. A. Sydko.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 443-453, 1968. 2 tab, 3 fig.

Descriptors: *Salinity, *Leaching, *Desalination, *Semiarid climates, *Economic feasibility, Saline soils, Drainage systems, Soil-water-plant relationships, Loess, Irrigation practices, Drainage effects, Salts, Groundwater, Evaporation, Irrigation effects, Crop production, Cotton, Arid lands.
Identifiers: *USSR, *Golodnaya Steppe.

The Golodnaya Steppe, located in the Middle Asian part of the USSR is characterized by a hot, dry climate. Semiarid loess soils prevail. They are suitable for irrigation except for excessive salinity resulting from a high evaporative potential and shallow groundwater. The authors conducted research to develop a method for rapid desalinization to reclaim these soils. Drainage was provided to lower the water table and leaching was started at rates of 8.2 to 71x10 super 3 cubic meters/ha. Over a period of 1 - 5 months the soils were leached to a depth of 0.7 to 9.5 m. Residual salts within this depth were well below the safe limit. Data showed that faster leaching rates required increased amounts of fresh water per unit of salt removal. High leaching rates were not economically feasible nor were very low rates, since they did not remove sufficient salts to permit crop yields. The authors conclude that a leaching rate of about 10x10 super 3 cubic meters/day is the economical optimum. Deep drainage and application of irrigation water at sufficient rates prevented secondary salinization. (Crouse-Arizona)
W70-02441

BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05B.
W70-02442

2H. Lakes

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
State Hydrological Inst. (USSR).
For primary bibliographic entry see Field 02A.
W70-02233

EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
British Columbia Univ., Vancouver. Dept. of Zoology.
Barry T. Hargrave.
Journal Fisheries Research Board of Canada, Vol 26, No 8, p 2003-2026, 1969. 13 fig, 6 tab, 38 ref.

Descriptors: *Primary productivity, *Sediments, Photoperiodism, Carbon Cycle, Temperature, Light, *Benthic fauna, Benthic flora, Efficiences, Sediment-water interfaces, Lakes, Oxygen, Regression analysis.
Identifiers: *Marion Lake (British Columbia), *Algal production, *Bacterial respiration, *Community respiration, Epibenthic production, British Columbia, Carbon flux, Antibiotics, Macrofaunal respiration, Depth effects.

Author measured gross epibenthic algal production and community respiration by following dissolved oxygen changes over undisturbed sediment cores, and bacterial respiration by measuring difference in total community respiration following addition of antibiotics. Macrofaunal respiration was measured and annual carbon flux was estimated. Oxygen production by epibenthic algae was directly related to temperature, light, and community respiration, and inversely related to day length. Photosynthetic efficiency was estimated at 0.4 to 3.1%, increasing with water depth over sediment. Community respiration was curvilinearly related to temperature, oxygen concentration, and day length. Bacterial respiration constituted 30% of total community respiration in summer and 45% in winter. Macrofaunal and epibenthic algal respiration accounted, respectively, for 33% and 23% of community respiration. Net production was estimated at 85% of gross production for summer. Production of epibenthic algae was estimated as 40 grams carbon/square meter per year. Temperature was most important variable influencing oxygen production and consumption. Author states that primary production on sediments exceeds that of the water column. Tabular data include multiple regression analyses, partitioning of community respiration, annual gross oxygen production, and consumption by depth, and comparisons of Marion Lake data with other published reports. (Voigtlander-Wis)
W70-02244

AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
Vermont Univ., Burlington. Dept. of Botany.
Philip W. Cook.
Vermont Resources Research Center, Completion Report, 1969. 2 p. OWRR A-009-VT.

Descriptors: *Phytoplankton, *Lakes, Bioindicators, Water quality, Chlorophyll, Biomass, Vermont.
Identifiers: *Autecology, Lake Champlain (NY-Vt), Shelburne Bay (Vt), Burlington Bay (Vt).

Results are reported of a project initiated to examine the biology of selected dominant species of the phytoplankton which are of potential value as indicators of water quality. Samples were collected at approximately weekly intervals during July-August 1968 from two sites in Lake Champlain (Shelburne Bay and a station located approximately two miles from Burlington Bay). Chlorophyll concentration of freshly collected samples were determined, and other samples were preserved for subsequent enumeration of their phytoplankters, after sand filtration. Values for chlorophyll concentration ranged from 3.5 to 11.4 milligrams chlorophyll/cubic meter. Total numbers of phytoplankters for each sample were well correlated with its chlorophyll concentration. (Eichhorn-Wis)
W70-02247

LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
G. E. Hutchinson, and Jane K. Setlow.
Ecology, Vol 27, No 1, p 13-22, Jan 1946. 3 fig, 20 ref.

Descriptors: *Connecticut, *Limnology, *Lakes, Bacteria, Seston, Detritus, Hypolimnion, Phytoplankton, Vitamins, Cyanophyta, Temperature, Lactobacillus, Ice, Chlorophyta, Seasonal, Phosphates, Depth, Epilimnion, Eutrophication, Chlorella, Water pollution sources, Physiological ecology.
Identifiers: *Niacin, Oscillatoria Rileyi, Oscillatoria prolifica, Biotin, Myxophyceae, Linsley Pond (Conn), Lactobacillus arabinosus, Lactobacillus casei, Raphidiopsis, Aphanizomenon gracile, Fragilaria crotonensis, Synedra, Asterionella formosa, Dinobryon, Anabaena, Thiamin, Vertical variation, Antibiotics, Chlorellin.

Concentrations of dissolved niacin in surface waters of Linsley Pond varies from 0.15 to 0.89 gamma/liter. High values (over 0.7 gamma/liter) are found only when ice-cover is present or is breaking up. Sestonic niacin per unit volume of water varies from 0.05 to 0.87 gamma/liter. Living phytoplankton, mostly Oscillatoria, apparently contains 50 to at least 100 gamma niacin/gram. Vertical variations in niacin content of unfiltered water, sampled during full summer stratification, depend primarily on variation in sestonic niacin. Seston from lower hypolimnion, presumably largely detritus, contains 22 gamma niacin/gram of total dry matter, or 33 gamma/gram of dry organic matter. Concentrations of dissolved biotin in Linsley Pond probably vary between 0.0003 gamma/liter and 0.004 gamma/liter, and sestonic biotin, over the same general range. No antibiotic substance, active against bacteria, was detected in either Linsley or Bantam Lake at end of spring phytoplankton bloom. Authors suggest that the general course of niacin decomposition by bacteria in lakes is similar to that in soils, and that such auxo-heterotrophic phytoplankters as occur in lakes will prove to be winter species. (Jones-Wis)
W70-02250

ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
Wisconsin Univ., Madison. Dept. of Zoology.
Joseph F. Koonce.
MS Thesis, Wisconsin Univ, Madison, 1969. 63 p. 12 fig, 4 tab, 87 ref.

Descriptors: *Phytoplankton, *Productivity, *Biomass, *Acidic water, *Bogs, *Lakes, Photosynthesis, Nannoplankton, Chrysophyta, Chlorophyta, Hydrogen ion concentration, Stratification, Conductivity, Sampling, Carbon dioxide, Chlorophyll, Organic compounds, Dissolved oxygen, Carbon radioisotopes, Diurnal, Fluctuation, Primary productivity, Electrical conductance, Bicarbonates, Alkalinity, Ions, Temperature, Light intensity, Euglenophyta, Dystrophy, Nutrients, Wisconsin, Oligotrophy, Cyanophyta, Diatoms.
Identifiers: Lake Geri (Wis), Flagellates, Dinophyceae, Desmids, Vilas County (Wis), Penney Lake (Wis), Peridinium limbatum, Peridinium cinctum, Peridinium inconspicuum, Oocystis solitaria, Cosmarium bioculatum, Ochromonas, Chrysococcus rufescens, Cryptophyceae, Baccillariophyceae, Myxophyceae, Depth effects.

An attempt was made to quantify the contribution of nannoplankton to biomass of an acid bog lake and to correlate biomass with production. A small bog pond in northern Wisconsin, Lake Geri, was selected for study. Two methods were used to estimate production uptake of carbon dioxide as indicated by diurnal changes in electrical conductance over the entire water column at four stations in the pond. A gross photosynthesis of 69 milligrams carbon/square meter per hour was measured on 12 September 1968. Phytoplankton of the pond consisted mainly of nannoplankton, and flagellates accounted for 70-89% of the total biomass. At least 25 species, with cellular volumes ranging between 1 and 32, 000 cubic micra, occurred in Lake Geri during period of study. Dinophyceae, Chrysophyceae, and Chlorophyceae, contributed importantly--in that order--to phytoplankton of the pond. Desmids were highly diversified and Nygaard's compound composition index for pond was 0.83. Average total biomass for water column of 3 meters ranged between 4.1 and 2.4 grams/cubic meter. (Jones-Wis)
W70-02252

A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
Public Health Service, Cleveland, Ohio.
Victor L. Casper.
Michigan Univ, Ann Arbor, Great Lakes Research Division, Publication No 13, p 29-35, 1965. 2 fig, 3 tab, 11 ref.

Descriptors: *Phytoplankton, *Eutrophication, *Lake Erie, Cyanophyta, Sampling, Dissolved oxygen, Nitrogen, Nitrates, Lakes, Diatoms, Chlorophyta, Seasonal, Chemical stratification,

Phosphorus, Climatic data, Hydrogen ion concentration, Alkalinity, Conductivity, Chemical oxygen demand, Physical properties, Temperature, Surface waters, Photosynthesis, Respiration, Light penetration, Productivity, Biochemical oxygen demand, Organic matter, Nitrogen fixation, Water pollution effects.
Identifiers: Anacystis cyanea, Oscillatoria, Carteria, Aphanizomenon holsaticum, Anabaena circinalis, Detroit River, Maumee River, Cladophora, Stephanodiscus, Bottom, Glenodinium, Cyclotella, Chlamydomonas, Depth effects.

Lake Erie exhibits symptoms of organic enrichment; temporal shifts in dominant algal genera, from diatoms to greens and blue-greens (cyanophytes) are occurring. On 9 and 10 September 1964, biologists at Great Lakes-Illinois River Basins Project's Lake Erie Program Office investigated a bloom of cyanophytes in western Lake Erie. The bloom, consisting primarily of Anacystis cyanea, Oscillatoria sp, Carteria sp, Aphanizomenon holsaticum, and Anabaena circinalis, covered approximately 800 square miles. Plankton and chemical samples were collected from top, middle and bottom depths, and color photographed. Extreme vertical variations in biological and chemical parameters often occur. During the bloom, total nitrogen (N) was high, and nitrate-N very low. Inorganic N has probably become limiting for phytoplankton production; high concentrations of soluble phosphorus suggest that it was not limiting. During the day dissolved oxygen was at saturation or above. Plankton counts were quite variable. In early morning, algae were well dispersed top to bottom due to light wind, but by afternoon they were concentrated in upper two feet, forming a dense scum. On 11 September, high winds, together with a cold front and rain, were followed by several cloudy days, and the bloom was not observed again. (Jones-Wis)
W70-02254

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I: FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Heinz Stefan, and F. R. Schiebe.
Available from the Clearinghouse as PB-188 512, $3.00 in paper copy, $0.65 in microfiche. Project Report No 101, Dec 1968. 72 p, 17 fig, 11 ref, 4 append. FWPCA Contract WP-913-04.
Identifiers: *Thermal stratification, Impoundments, *Cooling water, Thermal pollution, Stratified flow, *Outlets, Discharge (Water), Water temperature, Heat flow.

Information on some of the processes producing temperature and velocity distribution when heated water is discharged from a channel into a deep impoundment was obtained in laboratory experiments using a 40 ft long, 0.5 ft wide, 1.2 ft deep glass-walled flume. Dimensionless parameters and control mechanisms which produce various forms of stratification near the outlet were investigated specifically. Velocity and temperature distributions were measured in vertical cross sections at various distances from the outlet. Formation of stable stratification was observed using dye.
W70-02393

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II: TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Frank R. Schiebe, Heinz Stefan, and Norio Hayakawa.
Available from the Clearinghouse as PB-188 513, $3.00 in paper copy, $0.65 in microfiche. Project Report No 102, Dec 1968. 55 p, 13 fig, 1 tab, 3 ref, 3 append. FWPCA Contract WP-913-04.
Identifiers: *Thermal stratification, *Instrumentation, *Velocity, Current meters, *Water temperature.

A combination of a thermistor probe and a buoyant tethered sphere was developed to measure the temperature and velocity fields in a thermally stratified flow in a laboratory experiment. The velocity probe is able to measure velocities from 0.01 to 0.2 fps. Velocities are derived from the magnitude and the direction of the sphere deflection. The methods of data acquisition and data processing are described. Flow charts are included.
W70-02394

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III: TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
Heinz Stefan, and F. R. Schiebe.
Available from the Clearinghouse as PB-188 514, $3.00 in paper copy, $0.65 in microfiche. Project Report No 103, Dec 1968. 105 p, 36 fig, 1 tab, 7 ref. FWPCA Contract WP-913-04.
Identifiers: *Thermal stratification, Impoundments, Lakes, *Cooling water, Thermal pollution, Stratified flow, *Outlets, Discharge (Water), Water temperature, Heat flow.

Information on some of the physical processes producing temperature and velocity distribution when heated water is discharged from a channel into a wide and deep impoundment was obtained in several laboratory experiments. Both the outlet channel and the receiving tank had rectangular cross sections, but the tank was more than thirty times wider and deeper than the channel. Measurements of local velocities were made with a tethered buoyant sphere. Temperatures were also measured and some surface spreading patterns were recorded photographically. Investigated densimetric Froude numbers and Reynolds numbers at the outlet ranged from 0.6 to 7.2 and from 1500 to 9600, respectively.
W70-02395

THERMO-HYDRODYNAMICS OF STREAMS AND RESERVOIRS - GRAPHICAL METHOD FOR THE PREDICTION OF WATER TEMPERATURES WITHIN AND DOWNSTREAM FROM RESERVOIRS.

TVA, Division of Water Control Planning, Engineering Laboratory, Laboratory Report No 1, Aug 1967. 3 fig, 7 ref.

Descriptors: *Thermal stratification, *Water temperature, *Reservors, Heat budget, Isotherms, Thermal conductivity, Thermocline, Tennessee Valley Authority Project, Dissolved oxygen, Mixing, Thermal properties.

Graphical solution of stratification in reservoirs is presented based on the following assumptions: (1) water temperature is the only factor determining the density of water; (2) the heat exchange between the reservoir surface and the climatic environment takes place only in a 10-foot surface layer; (3) the temperature of this layer corresponds to the equilibrium temperature and can be computed from the heat budget equation; (4) each small water parcel incoming into the reservoir spreads out into a horizontal layer at its corresponding temperature; (5) no change of temperature and no mixing occurs between inflow water and reservoir water; (6) the withdrawal of water is assumed to affect only a layer between the bottom and top of the intake; (7) water is withdrawn from the horizontal layer extending over the whole area of the reservoir at intake level; and (8) the body of water becomes gradually homogeneous between the surface temperature and the corresponding isotherm at depth z in the fall. The method developed for temperature stratification prediction can be extended to dissolved oxygen distribution. (Novotny-Vanderbilt)
W70-02397

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
Texas Electric Service Co., Fort Worth.
For primary bibliographic entry see Field 05B.
W70-02400

HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
K. Starmach.
Verh, Internat Verein Limnol, Vol 14, p 643-646, July 1961.

Descriptors: *Biological properties, *Reservoirs, *Impoundments, *Plankton, Temperature, Aquatic environment, Plant growth, Fish, Ecology, Water quality, Aquatic algae, Zooplankton, Bacteria.

The impoundment reservoir Goczalkowice was constructed from 1951-56. The drainage area is about 739 sq km and is located mainly in mountain area (Carpaten). The municipal and industrial pollution coming into this reservoir is not yet significant. The average summer temperature of air is about 15 deg C within the 60 to 70-day period and the average daily temperature in winter is below zero about 100 days. Biological investigations have been pursued since 1955 and the results are presented with corresponding chemical characteristics. (Novotny-Vanderbilt)
W70-02404

PRELIMINARY REPORT OF TEMPERATURE AND OXYGEN UPTAKE IN THE LAKE SCHLIERSEE IN 1956 (GERMAN),
F. Wilhelm.
Limnol Schriftenreihe, Vol 5, No 19, p 40-65, 1958. 31 ref.

Descriptors: *Temperature, *Lakes, Heat balance, Thermal properties, Thermal stratification, Thermocline, Epilimnion, Hypolimnion, Dissolved oxygen, Heat, Limnology, Oxygen, Thermometers, Energy transfer.

The temperature and dissolved oxygen conditions of the lake from the standpoint of mixing and heat exchange (energy exchange) due to seasonal changes are described. The wind effect on temperature currents is taken into account. A strongly mixed epilimnion and then strongly mixed upper part of the hypolimnion are established, and below them, the relatively quiet hypolimnion exists. The energy exchange also influences the formation of the temperature gradient between the epilimnion and the hypolimnion. In the northern part of the lake, the influence of a tributary is noted and very low concentrations of oxygen were observed in the hypolimnion layers during the summer period. (Novotny-Vanderbilt)
W70-02406

EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
Tennessee Valley Authority, Chattanooga. Div. of Health and Safety.
M. A. Churchill, and W. R. Nicholas.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 93, No SA6, p 73-90, Dec 1967. 10 fig, 1 tab, 7 ref.

Descriptors: *Impoundments, *Dissolved oxygen, *Thermocline, *Stratification, Water storage, Water quality, Eutrophication.
Identifiers: Tennessee River Reservoirs, Multiple regression technique.

Changes occurring in the quality of water during its passage through Tennessee River reservoirs and during lengthy storage in tributary impoundments

are observed. Seasonal variations of temperatures of water discharges from main-river impoundments are discussed. DO concentrations in the water discharged from main-river reservoirs recede during the summer months but do not reach low concentrations observed below storage impoundments. Both total coliform and fecal coliform concentrations in main-stream reservoirs increase greatly below local municipalities. In tributary storage impoundments strong thermoclines develop in early spring, and relatively cool water, low in DO, is discharged through low-level power intakes well into or throughout the summer. Low DO concentrations are also caused by biological activity in eutrophic impoundments, inflows to which are otherwise relatively free of pollution. A multiple regression technique is used to develop an equation for predicting DO concentrations to be expected in releases from a proposed impoundment. (Rietveld-Vanderbilt)
W70-02411

2I. Water in Plants

THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02G.
W70-02426

ATRIPLEX POLYCARPA: II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
California Univ., Riverside. Dept. of Agronomy; and California Univ., Riverside. Dept. of Soils and Plant Nutrition.
N. J. Chatterton, C. M. McKell, J. R. Goodin, and F. T. Bingham.
Agronomy Journal, Vol 61, p 451-453, May-June 1969. 2 fig, 10 ref.

Descriptors: *Boron, *Southwest U.S., *Germination, *Plant growth, *Forages, Arid lands, Soil chemical properties, Desert plants, Ranges, Crop response, Plant populations, Seeds, Toxicity, Resistance.
Identifiers: *Desert saltbush.

Some of the arid soils of the southwestern U.S. have relatively high boron levels. A plant tolerant to boron might be a potentially valuable forage crop for arid range lands. The authors report a greenhouse study of boron tolerance of Atriplex polycarpa (desert saltbush), a shrub native to southwestern deserts. Germination was not affected by boron; growth varied among populations but generally was not affected by boron concentrations in culture solutions up to 40 ppm. Growth was somewhat reduced at 80 ppm. (Crouse-Arizona)
W70-02438

2J. Erosion and Sedimentation

BEACH LAMINATION: NATURE AND ORIGIN,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02L.
W70-02057

SUSPENDED SOLIDS MONITORING: A COMPARISON BETWEEN THREE INSTRUMENTS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-02067

HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
Utah State Univ., Logan. Coll. of Engineering.
For primary bibliographic entry see Field 08B.
W70-02070

HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
Geological Survey, Fort Collins, Colo.
Neil S. Grigg, and R. E. Rathbun.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 Price $2.75. Geol Surv Res 1969, Prof Pap 650-B, p B77-B80, 1969. 4 p, 4 fig, 12 ref.

Descriptors: *Sedimentation, *Settling velocity, Deposition (Sediments), Particle shape, Particle size, Sedimentation rates, Suspension, Bed load, Tractive forces, Shear drag, Reynolds number.
Identifiers: *Hydraulic equivalence (Settling rate), Sediment reentrainment.

The concept of hydraulic equivalence has evolved to mean that grains having equal fall velocity tend to be of equivalent hydraulic value. However, calculations based on standard fall-velocity relations and Shields' criterion for critical shear stress suggest that grains having the same fall velocity but different specific gravities will require different shear stresses for initiation of motion. These calculations suggest for grains moving in traction, subject to continuous deposition and reentrainment, that equal fall velocity alone should not be a sufficient criterion to assure that the grains will be of equivalent hydraulic value. (Knapp-USGS)
W70-02074

THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07B.
W70-02075

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02L.
W70-02082

SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
Geological Survey, Portland, Oreg.
C. A. Onions.
Geol Surv Open-file Rep, Feb 1969. 45 p, 1 fig, 2 tab, 2 ref.

Descriptors: *Sediment transport, *Oregon, *Data collections, Streamflow, Sediment discharge, Sediment yield, Bed load, Suspended load, Particle size, Turbidity.
Identifiers: *Umpqua River Basin (Ore).

Tables of a suspended-sediment data collected from 1956 to 1967 at 10 sites in the Umpqua River basin are presented. Computations based on these data indicate that average annual suspended-sediment yields at these sites range from 137 to 822 tons per square mile. Because available data for the Umpqua River basin are generally inadequate for accurate determinations of sediment yield and for the definition of characteristics of fluvial sediments, recommendations are made for the collection and analysis of additional sediment data. (Knapp-USGS)
W70-02097

POSITION OF REGIONAL CARBONATE/NON-CARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST: POSSIBLE CLIMATIC INDICATOR,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.; and Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.
For primary bibliographic entry see Field 02L.
W70-02098

TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
IBM Watson Research Center, Yorktown Heights, N.Y.
J. S. Smart.
Geol Soc Amer Bull, Vol 80, No 9, p 1757-1773, Sept 1969. 17 p, 3 fig, 9 tab, 26 ref.

Descriptors: *River basins, *Topography, *Drainage systems, *Synthetic hydrology, *Statistical methods, Probability, Statistics, Networks, Channel morphology, Stochastic processes.
Identifiers: Drainage basin morphology, Topology, Strahler stream numbers.

There are tow common ways of describing the topological properties of channel networks; one is to provide an exact description that gives all junctions and sources in sequence, and the other is to specify the Strahler stream numbers. For many purposes, the first method is too detailed and the second too broad. An intermediate method of classification, called 'ambilateral,' is proposed. The basic rule of this classification scheme is that two topologically distinct channel networks (TDCN) belong to the same class if one can be converted into the other by reversal of the right-left order at one or more junctions. Calculations based on an idealized model suggest that the ambilateral classification is more closely correlated with geomorphic and hydrologic properties than is the usual stream-number classification. Most tests for randomness require that the sample of networks be selected without regard to order, a condition that is not satisfied by much of the published data. In order to obtain a suitable sample, 86 networks ranging in magnitude from 23 to 1172 were determined from stream systems in the United States. The statistical analyses generally support Shreve's hypothesis of topological randomness. (Knapp-USGS)
W70-02101

A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
Bundesanstalt fuer Wasserbau, Karlsruhe (West Germany).
For primary bibliographic entry see Field 08B.
W70-02103

PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 08B.
W70-02104

SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
Netherlands Rijkswaterstaat, Arnhem; and Waterloopkundig Laboratorium, Delft (Netherlands).
For primary bibliographic entry see Field 08B.
W70-02105

SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
Direccao Geral dos Servicos Hidraulicos, Lisbon (Portugal); and Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
For primary bibliographic entry see Field 08B.
W70-02107

CANAL SHOALING STUDIES,
Corps of Engineers, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-02108

MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
Ministry of Irrigation (Egypt). Delta Barrage.
For primary bibliographic entry see Field 08B.

W70-02109

MECHANICS OF BED FORMATIONS,
Robert Coll., Istanbul (Turkey).
For primary bibliographic entry see Field 08B.
W70-02149

EROSION FROM ABANDONED COAL-HAUL ROADS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-02215

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
Volga River Hydrometeorological Observatory.
For primary bibliographic entry see Field 02L.
W70-02230

TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
V. I. Matyukhin, and O. N. Prokof'yev.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 146-150, 1967. 5 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Sediment transport, *Hydraulic models, *Particle size, *Streamflow, *Velocity, Suspended load, Suspension, Model studies, Photometry, Colorimetry, Flow measurement, Sands, Computers.
Identifiers: *USSR, Suspended-particle velocity transfer.

Horizontal transport of suspended particles of various sizes by streamflows was investigated by using an experimental device consisting of two concentric cylinders and photoelectric and electronic detecting and recording elements. The transport data were obtained by using sands of various sizes and concentrations suspended in the streamflow. The study shows that particles are transported by horizontal streamflow with a velocity equal to the streamflow velocity, if the velocity is in a 120-700 m/hr interval. (Gabriel-USGS)
W70-02231

SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965,
Agricultural Research Service, Oxford, Miss.
F. E. Dendy, and W. A. Champion.
Prepared under the auspices of the Water Resources Council, Committee on Sedimentation, US Department of Agriculture, Miscellaneous Publication 1143, p 1-64, May 1969. 64 p, 1 map, 3 tab.

Descriptors: *Deposition (Sediments), *Reservoir silting, Water storage, Reservoir storage, Watershed management.

Data from known reliable reservoir sedimentation surveys made in the United States through 1965 are summarized in this bulletin. Additional data from surveys made after 1965 are included for a few reservoirs. The reservoirs are located in all of the 48 conterminous United States, except Maine and Florida, and in Puerto Rico. In addition to data on storage reservoirs and ponds, some information on debris basins is included. Information in this bulletin and in the supplement should prove useful to engineers and watershed planning specialists in private and public practice who are concerned with problems of reservoir sedimentation.
W70-02262

SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION: AN APPLICATION OF MULTIVARIATE STATISTICS,
Toronto Univ. (Ontario); and Scarborough Coll., Toronto (Ontario). Dept. of Geography.
Brian Greenwood.
Canadian J Earth Sci, Vol 6, No 6, p 1347-1358, Dec 1969. 12 p, 8 fig, 5 tab, 62 ref.

Descriptors: *Sands, *Beaches, *Dunes, *Sedimentary structures, *Statistical methods, Correlation analysis, Sampling, Regression analysis, Ripple works, Erosion, Deposition (Sediments).
Identifiers: Factor analysis, Discriminant analysis.

Multivariate discriminant analysis is shown to be a useful tool in delineating sedimentary environments on the basis of quantitative sediment properties. Size-frequency statistics calculated by moments provide environmental indicators for beach and aeolian sands from Barnstaple Bay, England. Linear discriminant analysis proves useful in classifying sediments of unknown origin and of varied mineralogical composition. (Knapp-USGS)
W70-02303

HYDROLOGY ANNUAL NO. 14 - 1966.
Ministry of Works, Wellington (New Zealand).
For primary bibliographic entry see Field 02E.
W70-02307

LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
Geological Survey, Washington, D.C.
Harold P. Guy.
Available, Supt Documents, US Government Printing Office, Washington, DC-Price $0.65. Geol Surv Tech Water-Resources Invest, Book 5, Chapter C1, 1969. 58 p, 18 fig, 7 tab, 21 ref.

Descriptors: *Analytical techniques, *Sedimentology, *Sediments, Particle size, Suspended load, Bed load, Particle shape, Mineralogy, Specific gravity, Organic matter, Dissolved solids, Sieve analysis, Settling velocity, Theoretical analysis.
Identifiers: *Sediment analysis, *Manual series, Suspended sediment, Bed material, VA tube pipet, BW tube-VA tube.

Theories and methods used by the Water Resources Division, U.S. Geological Survey, for analysis of fluvial sediments to determine the concentration of suspended load and the particle-size distribution of both suspended sediments and bed materials are given. Other analyses related to these determinations may include particle shape, mineral content, specific gravity, organic matter, and dissolved solids of the samples, and specific weight of the soils. The evaporation and filtration methods for concentration analysis are discussed. Methods used for particle-size analysis of suspended sediment samples may include the sieve-pipet, the VA tube-pipet, or the BW tube-VA tube. The selection of method depends on the equipment available, the concentration and approximate size of sediment in the sample, and the settling medium used. The choice of method for most bed-material samples is usually limited to procedures suitable for sand or to some type of visual analysis for large sizes. (Carstea-USGS)
W70-02316

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
Geological Survey, Fort Collins, Colo.
Neil S. Grigg.
Geol Surv Open-file Rep, June 1969. 142 p, 36 fig, 6 tab, 32 ref, append.

Descriptors: *Sediment transport, *Bed load, *Model studies, *Hydraulic models, Statistical methods, Sedimentation, Channel morphology, Turbulent flow, Tracers, Radioisotopes, Stochastic processes, Probability, Regression analysis.
Identifiers: Flume studies.

The motion of single particles over ripple and dune beds was investigated in a laboratory flume. Statistical properties of the step lengths, rest periods and bed profiles were calculated and analyzed. Two bed material sizes were used. The investigation was made possible through the use of single high-activity radioactive particles. Medical tracer particles with specific gravity of approximately 2.65 were used. Median diameters were approximately 0.33 and 0.45 mm. In general, the tracers proved quite satisfactory for studies of this type. The measurement of the statistical properties of particle motion made possible the evaluation of a general two-dimensional stochastic dispersion model developed by Sayre and Conover (1967). It was found that the model predicted well the mean velocity of the centroid of a group of particles but underpredicted the rate of spreading of their concentration distribution. The particle step lengths followed the gamma distribution and the rest periods followed the exponential distribution. The distribution of bed form lengths followed a gamma distribution indicating a relation between step length and bed form length. Previously developed simple models may not be adequate to fully describe particle motion. (Knapp-USGS)
W70-02320

ROADSIDE EROSION SURVEY,
Soil Conservation Service, Madison, Wis.
William M. Briggs.
Soil Conservation, Vol 35, No 2, p 27-28, Sept 1969. 2 p, 1 fig, 2 photo, 1 tab.

Descriptors: *Erosion, *Erosion control, *Highways, *Wisconsin, *Surveys, Soil erosion, Bank protection, Land management, Diversion structures, Check structures, Soil conservation, Soil management, Water control.
Identifiers: Highway erosion.

A survey was made of roadside soil erosion in Wisconsin. Over 21,000 sediment-producing sites on 87,000 miles of road total 3,711 miles of erodible roadside. Town and county roads account for 97% of the erosion. Erosion control recommendations include seeding, mulching, sediment-control structures, and property acquisition. (Knapp-USGS)
W70-02327

CONSERVATION IN A NEW TOWN,
Soil Conservation Service, Hyattsville, Md.
John N. Holeman, and Elmer F. Sauer.
Soil Conservation, Vol 35, No 2, p 35-38, Sept 1969. 4 p, 10 photo.

Descriptors: *Sediment control, *Erosion control, *Construction, *Maryland, Road construction, Building codes, Design, Legislation, Excavation, Mulching, Gabions, Check structures, Riprap, Slope protection, Vegetation establishment.
Identifiers: Columbia (Md).

The sediment control program used in construction of the new town of Columbia, Maryland consists primarily of immediate stabilization of all cleared sites, followed by the earliest possible establishment of binding vegetation. Trees, natural topography, and ground cover are retained wherever feasible for the beauty and protection of each subdivision. Builders are urged to stabilize lots with at least partial seeding or sodding before turning them over to new owners. Check structures are used to control sediment transport in watercourses. Sediment traps and basins are installed downstream from all large cleared areas. Stream banks are protected by gabions and riprap. A sediment control ordinance regulates all construction practices. (Knapp-USGS)
W70-02329

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE

BARAKAR RIVER, BARAKAR, WEST BENGAL,
Indian Inst. of Tech., Kharagpur. Dept. of Geology and Geophysics.
Swapan Kumar Sarkar, and Sudhir Basumallick.
J Sediment Petrol, Vol 38, No 3, p 747-754, Sept 1968. 8 p, 13 fig, 12 ref.

Descriptors: *Sedimentation, *Erosion, *Geomorphology, *Sedimentary structures, *Channel morphology, Islands, Stratification, Stratigraphy, Sand waves, Currents (Water), Ripple marks, Sand bars, Sands, Gravels, Meanders, Mapping, Flood plains, Silts, Clays.
Identifiers: *India, West Bengal, Barakar River.

The formation of a channel island in the Barakar River of West Bengal was investigated on the basis of a detailed geological study. A number of sedimentary structures were recorded. In order of abundance these structures are as follows: cross-stratification, sand waves, ripple-drift laminae, deformation structures, current crescents, and ripple marks. The occurrence and abundance of these structures is well marked, as is the vertical structural variation. The presence of a clay band almost all over the island at a height of 10-11 feet indicates that the sand bar acted as a temporary flood plain when fine silt and clay were deposited from the suspended load of flood water. It seems that the point bar was evolved into a channel island through an intermediate stage of a channel bar and a temporary flood plain. In general, the growth of the island was due to initial lateral accretion and subsequent vertical accretion. (Gabriel-USGS)
W70-02331

DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
University of Southern California, Los Angeles. Dept. of Petroleum Engineering.
George V. Chilingarian, and Herman H. Rieke, III.
J Sediment Petrol, Vol 38, No 3, p 811-816, Sept 1968. 6 p, 4 fig, 2 tab, 32 ref.

Descriptors: *Sedimentation, *Sedimentary rocks, *Diagenesis, *Consolidation, *Water chemistry, Pressure, Moisture, Clay minerals, Montmorillonite, Kaolinite, Salinity, Mud, Permeability, Clays, Organic matter, Calcium, Chlorine, Magnesium, Sodium, Potassium, Sulfates, Ions.
Identifiers: Fine-grained sediment consolidation.

The process of consolidation of fine-grained sediments was investigated on the basis of experiments with pressure versus sediment moisture content. The analysis of pressure-moisture curves leads to the overall conclusion that upward deviations of the curve from linearity are caused by the squeezing out of non-oriented water first. These deviations occur at pressures corresponding to about 20-25% remaining moisture content for kaolinite and 50-70% for montmorillonite, that is, at pressures where the chemistry of the squeezed-out solutions begins to change appreciably. The salinity of interstitial solutions in shales should be less than that of water in associated sandstones, assuming that water was squeezed from the shale into the sandstone. (Gabriel-USGS)
W70-02332

SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
Geological Inst., Groningen (Netherlands).
Ph. H. Kuenen.
J Sediment Petrol, Vol 38, No 3, p 817-831, Sept 1968. 15 p, 10 fig, 2 tab, 25 ref.

Descriptors: *Sedimentation, *Convection, *Sediment load, *Settling velocity, Analytical techniques, Density, Vertical migration, Suspension, Saline water, Clays, Silts, Velocity, Compaction, Sea water.
Identifiers: Sediment settling processes.

Grain-size analysis by 'settling convection,' that is, by a system where the difference in density of clouds in a settling suspension generates a settling current, was investigated. Suspensions of silt and clay show active convection due to the development of clouds differing in density. In salt water the suspension density remains roughly constant for a long time while the volume of the suspension decreases. In peptized suspensions with densities between 20 and 0.1/gr/liter, convection is very active. A visual method is described for three-dimensional size measurement of flocculated lutum in sea water. Experiments conducted on elutriation in water (counter-current separation) give poor results in consequence of settling convection. (Gabriel-USGS)
W70-02333

A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 02L.
W70-02334

CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
Texas Christian Univ., Fort Worth. Dept. of Geology.
Arthur J. Ehlmann.
J Sediment Petrol, Vol 38, No 3, p 885-894, Sept 1968. 10 p, 4 fig, 5 tab, 7 ref.

Descriptors: *Erosion, *Weathering, *Clay minerals, *Rivers, *Puerto Rico, Paleoclimatology, Igneous rocks, Soils, Geology, Rainfall, River systems, Climates, Sands, Topography, Karst, Sampling, X-ray analysis, Petrology, Water analysis, Calcium, Magnesium, Sodium, Potassium, Streamflow.
Identifiers: *Clay mineralogy.

The island of Puerto Rico is composed of an east-west mountain range of andesitic to basaltic volcanics with lesser amounts of calcareous sediments. The stream loads of the islands contain halloysite, gibbsite, quartz, montmorillonite, vermiculite, and relatively-small amounts of chlorite and serpentine. The rivers of Puerto Rico, in general, reflect the climatic conditions present in their watersheds by their characteristic loads; however, because of the small volume of clay relative to the larger volume of mineralogically unstable volcanic sand in the rivers, the bulk sediment being deposited offshore provides only slight indication of climatic conditions onshore. (Gabriel-USGS)
W70-02335

THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
University Coll., London (England).
I. J. Smalley, and C. Vita-Finzi.
J Sediment Petrol, Vol 38, No 3, p 766-774, Sept 1968. 9 p, 3 fig, 1 tab, 55 ref.

Descriptors: *Loess, *Deserts, *Sands, *Fine aggregates, Aeolian soils, Glaciers, Dust storms, Energy transfer, Deposition (Sediments), Mechanical properties, Mineralogy, Quartz, Air temperature, Stress, Kinetics.
Identifiers: Desert loess.

Loess consists chiefly of quartz particles with diameters of about 20-50 microns. It is commonly thought to have formed in periglacial areas and in deserts. It has been suggested that direct glacial grinding could produce suitable particles. The existence of dust storms suggests that fine particles also form in hot, sandy deserts; these could be the result of interparticle contacts where a certain critical kinetic energy is involved. There are no loess deposits within sandy desert areas, but they may occur at the desert margins. The major loess provinces to which a desert origin has been ascribed either are not true loess or are explicable in terms of glacial origin. Of the minor deposits, only that of the Negev seems to have a well established desert origin. The quartz particles in the Negev deposit probably formed by simple impact. This mechanism does not seem adequate for the Chinese loess, and it is suggested that the widespread Pleistocene glacition of China was responsible for the bulk of the fine particles. Thus although loess particles can form mechanically in deserts, they have not done so on a scale sufficient to produce major loess deposits. Desert loess deposits should be distinguishable from glacial loess deposits by their size and their mineralogical nature. Stresses produced by temperature changes can break rocks. Most quartz is introduced into the sedimentary system as sand-size particles (about 500 microns), smaller than the critical break size. (Gabriel-USGS)
W70-02336

MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
Duke Univ., Durham, N.C. Dept. of Geology; and Duke Univ., Beaufort, N.C. Marine Lab.
For primary bibliographic entry see Field 02L.
W70-02338

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
California Univ., Davis. Dept. of Geology; and California Univ., Bodega Bay. Bodega Marine Lab.
Thomas W. Wood.
J Sediment Petrol, Vol 38, No 3, p 832-844, Sept 1968. 13 p, 1 fig, 2 tab, 55 ref.

Descriptors: *Weathering, *Erosion, *Mineralogy, *Paleoclimatology, *Stability, Kaolinite, Sodium, Potassium, Hydrogen, Rainfall, Topography, Temperature, Ion transport, Micrometeorology, Electron microscopy, Sampling.
Identifiers: Sacramento Valley (Calif), Eocene sandstone.

The Domengine formation, a middle Eocene sandstone located in the Sacramento Valley of California, was investigated to obtain a broad picture of the climatological-mineral stability relationship. The study of the kaolinitic weathering alteration of feldspar grains of the Valley samples indicates that orthoclase is more weathered than andesine. This process depends on the fact that under active leaching conditions, sodium ion emigration rates from plagioclase feldspar exceed potassium ion migration from orthoclase. Low relief, high non-seasonal rainfall, and subtropical temperatures would produce the required microchemical conditions, and sodium ion activity would be higher in soil water than that of K ion because Kions are continuously incorporated into plant tissues. Under favorable circumstances, gross climatological characteristics of ancient terranes can be deduced from mineralogical evidence. (Gabriel-USGS)
W70-02339

RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
Shell Oil Co., Midland, Tex.
For primary bibliographic entry see Field 02L.
W70-02340

2K. Chemical Processes

WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-02054

DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND

ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Geological Survey, Denver, Colo.
T. T. Chao, M. J. Fishman, and J. W. Ball.
Anal Chim Acta, Vol 47, p 189-195, 1969. 7 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Water analysis, *Trace elements, *Analytical techniques, *Spectrophotometry, *Anion exchange, Water chemistry, Ion exchange, Chelation.
Identifiers: *Silver, Ammonium pyrrolidine dithiocarbonate.

A method is described for the accurate determination of 0.1-1 microgram of silver per liter of water. The method permits stabilization of silver in water without loss to container walls. Optimum conditions have been established for the complete recovery of silver from water with an anion-exchange column, for quantitative elution of silver from the resin, and for measurement of silver by atomic absorption spectrophotometry after chelation with ammonium pyrrolidine dithiocarbamate and extraction of the chelate with MIBK. Silver in the 1-10 microgram/l range can be determined by extraction without pre-concentration on an ion-exchange resin. (Carstea-USGS)
W70-02099

ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
Pittsburgh Univ., Pa. Graduate School of Public Health.
For primary bibliographic entry see Field 05A.
W70-02112

THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
Wisconsin Univ., Madison. Dept. of Civil Engineering.
Robert K. Ham.
Water and Sewage Works, Vol 116, 1969 Ref No, p R90-R104, Nov 28, 1969. 15 p, 4 fig, 2 ref.

Descriptors: *Water chemistry, *Aqueous solutions, *Solubility, *Reviews, Water treatment, Water analysis, Equilibrium, Hydrogen ion concentration, Corrosion, Stability, Chemical precipitation, Saturation, Ions, Scaling, Chemical potential, Chemical reactions, Mineralogy.
Identifiers: Chemical equilibrium.

Frequently people working in the areas of water and wastewater treatment, who are not chemistry oriented, need a concise, reasoned, yet fundamental development of the chemical concepts which would be useful to them. A special effort is made to answer part of this request by providing a means for understanding the general use of chemical equilibria considerations. Starting with basic definitions and chemical concepts, the reasons for and the means of construction of log c-pH diagrams are presented. Some uses of the diagrams are indicated by calculating the pH of a pure solution; determining the concentrations of the various species in a solution in which the pH is externally set; and by describing the changes and their implications which occur during an alkalinity titration. Finally, the concept of solubility is introduced, and the use of most of the material presented throughout the paper is illustrated by a fairly complex precipitation problem. (Knapp-USGS)
W70-02292

DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. O. Van Everdingen.
Canadian J Earth Sci, Vol 6, No 6, p 1421-1430, Dec 1969. 10 p, 1 fig, 4 tab, 9 ref.

Descriptors: *Water chemistry, *Springs, *Spring waters, Thermal springs, Cold springs, Mineral water, Calcite, Dolomite, Gypsum, Carbonates, Sulfates, Mineralogy, Calcium carbonate, Calcium sulfate, Aqueous solutions, Solubility.
Identifiers: *Canada, Alberta, British Columbia.

Comparison of ion-activity products and equilibrium constants for solution of calcite, dolomite, and gypsum indicates that water from Fairmont Hot Springs and Banff Hot Springs, and from thermal springs in British Columbia, on Lussier River, Ram Creek and near Fording Mountain, are supersaturated with respect to calcite and, to a lesser extent, with respect to dolomite. At other springs saturation occurs after water is discharged from the springs. In the case of hot springs this is caused by the rise in pH that accompanies loss of excess carbon dioxide and, to a lesser degree, by evaporation; cooling of the water tends to lower the degree of saturation somewhat. At cold springs, increase in water temperature after discharge increases the degree of saturation. Only near-saturation with respect to gypsum is indicated for Miette Hot Springs, Fairmont Hot Springs, and Fording Mountain Springs; precipitation of gypsum may occur here owing to evaporation of part of the water; the effect of temperature on the degree of saturation is small. (Knapp-USGS)
W70-02301

MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
Bedford Inst., Dartmouth (Nova Scotia). Atlantic Oceanographic Lab.
D. M. Garner, and W. L. Ford.
Canadian J Earth Sci, Vol 6, No 6, p 1359-1363, Dec 1969. 5 p, 3 fig, 11 ref.

Descriptors: *Water chemistry, *Water temperature, *Sea water, *Atlantic Ocean, Oceanography, Dissolved oxygen, Currents (Water), Ocean currents, Water properties, Sampling, Water analysis.
Identifiers: *Mid-Atlantic Ridge.

Water was sampled during August and September 1968, in six basins in the floor of the Median Valley of the Mid-Atlantic Ridge near latitude 45 deg N, and in the open Atlantic each side of the Ridge. Measurements were made of temperature, salinity, dissolved oxygen, reactive silica, and dissolved fluoride. Water properties in the valley are practically homogeneous below a depth of about 2390 m, and are controlled by the depths of saddles in the adjacent ridge systems. No thermal or chemical anomalies were found in waters within the basins which might have been due to geothermal action in the valley floor. Relatively high concentrations of dissolved oxygen in basin waters suggest that the valley is efficiently flushed. (Knapp-USGS)
W70-02302

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
Michigan State Univ., East Lansing. Dept. of Geology.
Samuel B. Romberger.
Mich State Univ Proj Terminal Rep to Office Water Resources Res, July 1969. 29 p, 2 tab. OWRR Proj No B-007-MICH.

Descriptors: *Water chemistry, *Groundwater, *Michigan, Aquifers, Glacial drift, Clay minerals, Ion exchange, Filtration, Aqueous solutions, Groundwater movement, Geochemistry, Data collections, Hydrologic data.
Identifiers: *Lansing (Mich).

The factors controlling the chemistry of groundwater in the upper Grand River drainage basin in Central Michigan were studied. The major aquifer is the Saginaw Formation, of Pennsylvanian age, consisting of sandstone and shale with minor limestone and coal. The overlying glacial material acts as a minor aquifer. Representative subsurface water samples were analysed for the major constituents; a representative composition would be: 330 ppm total hardness; 4 ppm Na; 1 ppm K; 84 ppm Ca; 26 ppm Mg; 1 ppm Fe; 3 ppm C; 25 ppm sulfate; 300 ppm bicarbonate; pH 7.5. No lateral or vertical zoning of chemical constituents was observed. The chemical nature of the groundwater depended on the aquifer and its clay content. This relationship is attributed to an ion filtration process and base exchange reactions. Quantitative thermodynamic considerations of the data suggest the groundwater in the Saginaw is close to saturation with respect to the carbonates calcite and dolomite, but undersaturated with respect to gypsum. All dissolved materials determined appear to originate in the soils and glacial material. (Knapp-USGS)
W70-02328

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
Rensselaer Polytechnic Inst., Troy, N.Y.
For primary bibliographic entry see Field 02L.
W70-02337

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
California Univ., Davis. Dept. of Geology; and California Univ., Bodega Bay. Bodega Marine Lab.
For primary bibliographic entry see Field 02J.
W70-02339

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
Agricultural Radioisotope Lab. (Iraq); and Alexandria Univ. (Egypt).
For primary bibliographic entry see Field 02G.
W70-02430

2L. Estuaries

BEACH LAMINATION: NATURE AND ORIGIN,
Geological Survey, Menlo Park, Calif.
H. Edward Clifton.
Marine Geol, Vol 7, No 6, p 553-559, Dec 1969. 7 p, 3 fig, 14 ref.

Descriptors: *Sedimentation, *Beaches, *Waves (Water), *Sedimentary structures, Deposition (Sediments), Sediment transport, Sands, Mineralogy, Beach erosion.
Identifiers: *Beach laminations.

A distinctive two-fold sedimentation unit characterizes lamination in the upper swash zone of beaches. Within the unit a fine or a heavy mineral rich layer at the base grades upward into a coarser or a heavy mineral poor layer at the top. This distinctive type of lamination results from grain segregation within bed flow during wave backwash. In plan the sedimentation units formed by wave backwash take the form of irregular ellipses elongate parallel to the strand line. Two units, which were untruncated by younger layers and thus appeared to be complete, were mapped to establish their lateral distribution. One occurred in an ellipse 21 ft long by 10 ft wide; the other was larger (64 ft long by 34 ft wide) and more irregular. The size and shape of the units in plan probably depend on topography and wave size. The backwash bed flow process and resulting graded two-fold sedimentation unit should occur on all beaches where lamination is produced on the upper foreshore. The distinctive stratification should also be present in ancient beaches, providing a useful means for identifying such paleogeographically important deposits. (Knapp-USGS)
W70-02057

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
John R. Ritter.
Geol Surv Res 1969, Prof Pap 650-B, p B189-B193, 1969. 5 p, 6 fig.

Descriptors: *Bays, *California, *Tides, *Currents (Water), *Suspended load, Surveys, Sedimentation, Deposition (Sediments), Streamflow, Sediment transport, Sands, Silts, Clays, Discharge (Water), Flow measurement.
Identifiers: Bolinas Lagoon (Calif).

Measurement of water flow and sediment load at the lagoon inlet for a 10-hour tidal period (floodtide and ebbtide) on June 22, 1967, revealed that in that specific period of time 152 tons of suspended sediment were carried into the lagoon by the floodtide, whereas only 36 tons were carried out of the lagoon by the ebbtide. However, the major ebbtide which was not measured probably carried the largest load of the day. Bedload made up as much as 18% of the total load during floodtide and 15% during ebbtide. Ten water measurements and seven sediment measurements were made during the floodtide (lower low water to lower high water). Six water measurements and five sediment measurements were made during the ebbtide (lower high water to higher low water). One measurement each of water and sediment was made during the second floodtide. The maximum measured water flow and maximum average velocity during floodtide were 5,810 cubic feet per second and 3.5 feet per second, respectively; during ebbtide the maximums were 3,720 cfs and 2.4 fps. The range of floodtide was about 4 ft, and ebbtide about 1.3 ft. Higher temperatures of water at the inlet possibly indicated lagoon water and ebbtide, and lower ones, ocean water and floodtide. (Knapp-USGS)
W70-02082

SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
Geological Survey, Baton Rouge, La.
J. R. Rollo.
Louisiana Dept Conserv, Geol Surv, and Dept Public Works Water Resources Bull No 13, Aug 1969. 45 p, 4 fig, 6 plate, 1 tab, 9 ref.

Descriptors: *Saline water intrusion, *Aquifers, *Louisiana, *Surveys, Water quality, Hydrogeology, Data collections, Hydrologic data, Water levels, Groundwater movement, Coastal plains.
Identifiers: Baton Rouge (La).

Test wells drilled in the Baton Rouge area have defined large-scale faulting that cuts across the southern part of the area and acts as a hydraulic barrier to the northward movement of salty water. Salty water has been found in several aquifers north of the fault, but there is reasonable doubt that a significant quantity of salty water has moved or can move across the fault, except in the '400-foot' sands. The logical approach to any intrusion problem that can be envisioned should be one of cautious watchfulness. Until the salt-water fronts actually reach points of withdrawal, their flow paths from their known positions to the points of withdrawal are only generally predictable. When the salty water actually arrives, a method of control can be instituted with the certainty that the geographical location is correct and the benefits of control can be measured. (Knapp-USGS)
W70-02094

POSITION OF REGIONAL CARBONATE/NON-CARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST: POSSIBLE CLIMATIC INDICATOR,
Columbia Univ., Dobbs Ferry, N.Y. Hudson Labs.; and Rensselaer Polytechnic Inst., Troy, N.Y. Dept of Geology.
John E. Sanders, and Gerald M. Friedman.
Geol Soc Amer Bull, Vol 80, No 9, p 1789-1795, Sept 1969. 7 p, 1 fig, 50 ref.

Descriptors: *Paleoclimatology, *Quaternary period, *Sea level, *Water temperature, *Carbonates, Sedimentation, Sands, Glaciation, Water level fluctuations.
Identifiers: Paleoclimatic indicators, Lithologic boundaries.

In Holocene sediments along the Atlantic coast of eastern United States, the regional carbonate/non-carbonate boundary is located south of Miami, Florida. Study of the post-Cretaceous strata underlying the coastal plain and continental shelf indicates that this boundary has not remained fixed, but has shifted, presumably in response to changes of climate. Its movement to successively southward positions coincided with the times of cooling climate indicated by paleobotanical, paleobiological, and geochemical evidence. Position of the boundary enables comparison of Quaternary and pre-Quaternary climates. If the warmest Quaternary climates coincided with highest Quaternary sea levels, the northernmost position of the boundary should be recorded in the highest emerged marginal marine deposits of Quaternary age on the Atlantic Coastal Plain. Field evidence does not substantiate this prediction. In emerged Quaternary 'terraces' the northernmost boundary is located at about 27 deg N. lat, near its position during Late Cretaceous time. This suggests that during times of maximum Quaternary submergence the climate was only slightly warmer than it is today. If the northernmost position of the boundary is a reliable indicator of the time of maximum Quaternary warmth, then at least one time of great Quaternary warmth coincided not with a high sea level, but with a time of low sea level. (Knapp-USGS)
W70-02098

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT: 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
Geological Survey, Washington, D.C.
Walter B. Keighton.
Geol Surv Hydrol Invest Atlas HA-335, 2 sheet, 1969. 7 fig, 33 map, 1 tab, 6 ref.

Descriptors: *Water quality, *Delaware River, *Estuaries, *Droughts, Streamflow, Salinity, Dissolved oxygen, Path of pollutants, Water temperature, Solutes, Low flow.
Identifiers: Delaware River Estuary.

The effects of the 1961-1966 drought on the quality of water in the Delaware Estuary from Trenton, N.J. to Reedy Island, Delaware are discussed in a 2-sheet Hydrological Atlas consisting of text, maps, graphs, and tabulated data. During the last 2 years (1965-66) OF AN EXTENSIVE DROUGHT, SALINITY ADVANCED FARTHER UPSTREAM IN THE Delaware estuary than had been recorded previously. The farthest advance was in late summer and autumn when fresh-water flows into the estuary were lowest; salinity receded in late winter and early spring when snowmelt resulted in increased streamflow. The salinity at several locations in the estuary may be predicted from the discharge of fresh water at Trenton, if the discharge is steady. Fluctuations in discharge, or winds at the mouth of the estuary, often cause variations in the salinity. Dissolved-oxygen concentrations in the estuary are also seasonal. As early as May (1965-66) a considerable reach of the estuary had a dissolved-oxygen concentration of less than 1 mg/l, but by November the dissolved-oxygen concentration had recovered. The dissolved-oxygen deficit is related to the water temperature. In the summer river water is warm, the pollutants are oxidized more rapidly, and thus consume dissolved oxygen faster. (Knapp-USGS)
W70-02119

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
Volga River Hydrometeorological Observatory.
N. A. Yaroslavtsev.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 127-141, 1967. 15 p, 6 fig, 1 tab, 10 ref.

Descriptors: *Sediment transport, *Mathematical studies, *Shores, *Reservoirs, Sediment distribution, Waves (Water), Geology, Energy budget, Clays, Sands, Barriers, Dams.
Identifiers: *USSR, Kuibyshev Reservoir, Gorki Reservoir, Rybinsk Reservoir.

Wave energy equations and formulas were used to calculate sediment transport along reservoir shorelines, using data recorded at the Gorki, Kuibyshev, and Rybinsk Reservoirs of Central European USSR. The effects of sediment accumulation on erosional rock volume with or without natural and artificial barriers and the effects of wave energy on accumulation coefficients were analyzed and shown in curves and tables. In general the method can be applied only to shorelines consisting of poorly-consolidated sediments; however, it can be applied to some extent to the analysis of sediment transport along shorelines consisting of a complex of well indurated and poorly-consolidated rocks. (Gabriel-USGS)
W70-02230

ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
Joseph Shapiro, and Roberto Ribeiro.
Journal Water Pollution Control Federation, Vol 37, No 7, p 1034-1042, July 1965. 6 fig, 2 tab, 7 ref.

Descriptors: *Algae, *Sewage effluents, *Estuaries, Fresh water, Lakes, Silts, Phosphates, Nitrogen, Waste water (Pollution), Scenedesmus, Cyanophyta, Chlorophyta, Chlorophyll, Bacteria, Trace elements, Vitamins, Amino acids, Calcium, Ammonia, Nitrogen fixation, Iron compounds, Light penetration, Water pollution effects, Eutrophication.
Identifiers: *Algal growth, *Potomac River, Plectonema, Nostoc paludosum, Bleaching, Washington (DC).

Addition of effluents from secondary wastewater treatment plants to Potomac River greatly increases growth of both green (chlorophytes) and blue-green algae (cyanophytes) in proportion to the quantity of effluent added. As little as 5% effluent is effective, and 40% is not supraoptimal. Since cyanophytes are able to provide their own nitrogen supply through fixation of molecular nitrogen, phosphate is the sole nutrient responsible for limiting their growth. Chlorophytes require both phosphate and ammonium-nitrogen for growth. Removal of ammonia from effluents will control chlorophytes only, but phosphate removal will limit cyanophytes as well. Partial removal of phosphorus from effluents will control both algal groups to a degree commensurate with extent of removal. Normal phosphorus concentrations of the Potomac River are such that increases in these concentrations will stimulate further algal growth. The hypothesis that trace substances are not limiting was verified. Silt, affecting light penetration and adsorption of phosphates or ammonia onto silt particles may both lead to reduced algal growths. Solution of the silt problem, through building of dams, must be tied to programs for nutrient control. (Jones-Wis)
W70-02255

CATALOG OF TSUNAMIS IN ALASKA,
Hawaii Univ., Honolulu; and Coast and Geodetic Survey, Honolulu, Hawaii.
Doak C. Cox, and George Pararas-Carayannis.
Rep for sale from US Dept of Commerce, Environmental Sci Services Admin, Coast and Geodetic

Survey. World Data Center A Rep WDCA-T 69-1, May 1969. 39 p, 1 tab, 88 ref.

Descriptors: *Tsunamis, *Alaska, *Data collections, *Bibliographies, Ocean waves, Waves (Water), Earthquakes, Landslides, Pacific Ocean.
Identifiers: World Data Center.

All available data pertaining to tsunamis in Alaska are summarized and the well-studied tsunami of 1964 is described briefly. An extensive bibliography of this and other recorded events is included. The times elapsing between the earthquakes with which Alaskan tsunamis are associated and the sweeping of the shores by the first tsunami waves are so short that the determination of significant potential tsunami hazard must be made much more rapidly than in the Tsunami Warning System that serves the Pacific as a whole and is centered at Honolulu. Indeed, the determination must be made, in many cases, prior to the collection and analysis of mareographic data which; is the main basis for analysis to tsunami hazard in the Pacific System. The Alaska system relies primarily on rapid analysis of seismic data telemetered to its operating center at Palmer and secondarily on mareographic data similarly telemetered. For older tsunamis, this report contains essentially all of the information available and considerable discussion as to the reliability of such data. (Knapp-USGS)
W70-02289

THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
New Zealand Oceanographic Inst., Wellington. Dept. of Scientific and Industrial Research.
D. M. Garner.
New Zeal J Marine and Freshwater Res, Vol 3, No 2, p 201-208, June 1969. 8 p, 5 fig, 4 ref.

Descriptors: *Water temperature, *Seasonal, *Sea water, *Seashores, *Estuaries, Mapping, Gaging stations, Sampling, Salinity, Winter, Summer, Turbulence, Stratification, Thermocline.
Identifiers: *New Zealand.

Temperature-depth and surface salinity measurements of ocean water over the shelf around New Zealand were made in February and August-September 1967. The in-shore ends of the Subtropical Convergence are present off Castlepoint in the east and off Hokitika in the west. North of this boundary a fairly strong summer thermocline was identified. To the south of the convergence, vertical temperature stratification is weak, with a bottom temperature of 12 deg C. Surface salinity ranges from about 35.5 parts per thousand in the north to about 34.8 in the south. Extensive areas of lower salinity caused by drainage off the land are found off Fiordland, and the cold winter water east of South Island has salinities between 34.0 and 34.5 parts per thousand, indicating the intrusion of Subantarctic water. (Gabriel-USGS)
W70-02300

A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
Florida State Univ., Tallahassee. Dept. of Oceanography.
Ralph Gram.
J Sediment Petrol, Vol 38, No 3, p 863-868, Sept 1968. 6 p, 3 fig, 3 tab, 4 ref.

Descriptors: *Sedimentation, *Sediment distribution, *Florida, *Reefs, Bottom sediments, Mapping, Mineralogy, Worms, Waves (Water), Analytical techniques, Carbonates, Sampling, Stokes law, Velocity, Mathematical studies, Biological properties.
Identifiers: Seminole Shores (Fla), Sabellariidae reefs, Chlorite.

Heavy minerals and size distribution of bottom sediments and reef materials have been examined in a Sabellariidae reef at Seminole Shores, Florida, approximately 100 miles northeast of Miami. Heavy mineral and shell fragment percentages in the reef material are up to ten times greater than in the adjacent bottom sediment. This distribution results from the tendency of the worm Phragmatopoma lapidosa to utilize the finer mineral grain sizes and platy shell fragments in tube construction. Accordingly, these worms improve the sorting of the beach sediments to a significant degree. (Gabriel-USGS)
W70-02334

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
Rensselaer Polytechnic Inst., Troy, N.Y.
Gerald M. Friedman.
J Sediment Petrol, Vol 38, No 3, p 895-919, Sept 1968. 25 p, 32 fig, 5 tab, 86 ref.

Descriptors: *Geochemistry, *Geology, *Reefs, *Carbonate rocks, *Water chemistry, *Estuaries, Sea water, Climates, Continental Shelf, Coral, Algae, Lagoons, Mollusks, Mapping, Tertiary period, Salinity, Chlorides, Sulfates, Magnesium, Sodium, Potassium, Sampling, Faults (Geology), Iron, Copper, Uranium radioisotopes, Carbon.
Identifiers: *Gulf of Aqaba, *Red Sea.

The Gulf of Aqaba, a slightly hypersaline body of water, occupies a tectonic valley about 10 to 26 km wide. Its climate is hot and dry with the evaporation exceeding rainfall by 157 mm per year. Numerous reefs line the shelf (1/4 to 2 km wide), with coralline algae dominating the reefs environments, and sedimentary deposits and organisms forming a series of zones which vary as depth changes. The mineral composition of the reef-builders and reef-derived carbonate sediments is identical with that of other areas, such as Bermuda, the Bahamas, and Florida. Molluscan shells of the area are composed of low-magnesium aragonite and skeletons of corals of high-magnesium aragonite. Approximately linear relationships exist between barium and magnesium, barium and manganese, magnesium and manganese, iron and manganese, and iron and barium for coral, coralline algal, and molluscan skeletons and carbonate sands derived from them. (Gabriel-USGS)
W70-02337

MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
Duke Univ., Durham, N.C. Dept. of Geology; and Duke Univ., Beaufort, N.C. Marine Lab.
Orrin H. Pilkey, and Blake W. Blackwelder.
J Sediment Petrol, Vol 38, No 3, p 799-810, Sept 1968. 12 p, 12 fig, 23 ref.

Descriptors: *Sedimentation, *Sedimentary rocks, *Marine geology, *Carbonates, Mineralogy, Sands, X-ray diffraction, Mapping, Sampling, Continental Shelf, Magnesium, Calcite, Atlantic Ocean, Gulf of Mexico.
Identifiers: *Recent carbonate sediments.

A wide variety of sediments were examined in order to determine the factors controlling modern carbonate mineral distributions, that is of aragonite, calcite and Mg-calcite. The study was based on the X-ray diffraction analysis of 260 samples taken from the Atlantic Ocean and the Gulf of Mexico. The sand-sized fraction was utilized exclusively to insure making reliable identification of components. Aragonite and Mg-calcite are the most common minerals. The shelf of the Gulf of Mexico exhibits a more variable mineralogical content than the Atlantic shelf. Carbonate mineralogy exhibits a steady increase in low Mg-calcite with depth. No clear indication of the relative stability of aragonite and high Mg-calcite at great depths and no clearly-defined relationship between latitude and carbonate mineralogy were observed. (Gabriel-USGS)
W70-02338

RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
Shell Oil Co., Midland, Tex.
F. J. Lucia.
J Sediment Petrol, Vol 38, No 3, p 845-858, Sept 1968. 14 p, 23 fig, 8 ref.

Descriptors: *Sedimentary rocks, *Sedimentation, *Diagenesis, Geology, Carbonates, Clays, Sands, Muds, Gypsum, Anhydrite, Dolomite, Mapping, Tertiary period, Recent epoch, Gastropids, Igneous rocks, Algae, Core drilling.
Identifiers: *Netherlands Antilles, *South Bonaire.

The general sedimentation and diagenetic history of South Bonaire (north of the coast of Venezuela) was analyzed on the basis of geological, paleontological, and petrographic data. The recent sediments are filling a depression in the Pleistocene surface of the island and the following sequence of deposition can be postulated: (a) deposition of a 'Halimeda' grainstone; (b) deposition of a lithoclastic sediment with clay beds and cementation of this sediment to form a carbonate crust; (c) deposition of an intertidal pelleted lime mud; and (d) bedded gypsum deposition and dolomitization of the pelleted lime mud. Textural similarity of Recent gypsum and anhydrite, and subsurface anhydrite leads to a supposition that subsurface anhydrite represents anhydrite formed near the surface, or anhydrite replacing gypsum formed near the surface. (Gabriel-USGS)
W70-02340

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

SUL-BISUL ION EXCHANGE PROCESS: FIELD EVALUATION ON BRACKISH WATERS,
Elgin International Inc., Ill.
K. Schmidt, D. Senger, Dean Schwark, and H. Dalaly.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $2.75. Office of Saline Water Research and Development Progress Report No 446, May 1969. 139 p, 28 fig, 17 tab, 2 photo. OSW Contract No 14-01-0001-1487.

Descriptors: *Desalination processes, *Ion exchange, Resins, Anion exchange, Cation exchange, Water chemistry, Brackish water, Desalting plants, Mineral water, Sulfates, Alkalinity.
Identifiers: *Webster Sul-bi Sul desalting, Sul-bi Sul anion resin.

Data of anion resin performance were obtained through experimental studies for use in prediction of anion resin capacity and raw water requirements for rinse regeneration. Cation resin performance characteristics with brackish water supplies are not yet totally predictable. Cation resin performance characteristics are more dependent on the total mineral content of the supply and less dependent on the actual chemical composition. Modifications of existing ion exchange technology are necessary. The advantageous features of the Webster Sul-bi Sul desalting plant are listed. The Sul-bi Sul process can economically treat high mineral waters within the limitations of its operating range. High alkalinity and high sulfate content are essential for Sul-bi Sul anion resin performance utilizing the rinse regeneration technique. (Carstea-USGS)
W70-02047

STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
Gulf General Atomic, Inc., San Diego, Calif.
H. K. Lonsdale, C. E. Milstead, B. P. Cross, and F. M. Graber.

Available from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $1.25. Office of Saline Water Research and Development Progress Report No 447, July 1969. 115 p, 12 fig, 18 tab, 53 ref, 9 append. OSW Contract No 14-01-0001-1717.

Descriptors: *Reverse osmosis, *Desalination processes, *Membranes, Solutes, Phosphates, Ammonia, Nitrates, Bicarbonates, Electrolytes, Salts, Phenols, Boron, Cellulose, Research and development, Pesticides, Water quality, Flow.
Identifiers: *Solutes rejection, Cellulose triacetate membrane, Reverse osmosis membranes.

Reverse osmosis membrane salt-rejection data were obtained for phosphate, ammonia, nitrate, and bicarbonate as well as other salts and nonelectrolytes that are important in water quality. The product water should have a low buffer strength because the rejection of bicarbonate is quite high. Reverse osmosis data showed that phenolic compounds will not be highly rejected. Thus, some of the pesticides and herbicides in some natural waters will not be removed by cellulose acetate membrane in reverse osmosis. Boron as boric acid was not highly rejected. Cellulose 2.5-acetate membranes appear to reject salts less effectively than cellulose triacetate membranes. The permeability of membranes is weakly dependent on salt concentration whereas the influence of solvent-solute flow is not of fundamental importance. (Carstea-USGS)
W70-02048

FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
Aerojet-General Corp., El Monte, Calif.
E. R. Watson.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $1.00. Office Saline Water Research and Development Progress report No 429, May 1969. 61 p, 7 fig, 17 tab, 2 append. OSW Contract No 14-01-0001-1801.

Descriptors: *Desalination processes, *Desalination plants, *Reverse osmosis, *Pilot plants, Water quality, Calcium sulfate, Membranes, Ion, Manganese, Carbonates, Equipment, Scaling, Descaling.
Identifiers: *Mobile desalting plants.

Field operation of a 36-in. diameter pressure-vessel-type reverse osmosis system was studied over a seven month period. The quality of the product water was acceptable for the first five months of operation. Failure of adhesive-backed tape bonds used to splice two 20-in. sections of membrane was apparently responsible for the deterioration of the product water quality. Formation of calcium sulfate scale on the membrane surfaces limited the productivity. Removal of iron, manganese and carbonates by pretreatment procedures improved the production rates. It was concluded that the mechanical operation of the equipment was good. (Carstea-USGS)
W70-02050

BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
Goodrich (B. F.) Aerospace and Defense Products Co., Akron, Ohio.
C. J. Major, and Nathan F. Cardarelli.
Avail from Clearinghouse as AD-692 724, $3.00 in paper copy, $0.65 in microfiche. Aerospace Med Res Lab Rep AMRL-TR-69-17, Wright-Patterson AFB, Ohio, June 1969. 27 p, 3 fig, 16 tab. Air Force Contract No F33615-68-C-1266, Proj No 6373, Task No 637304, Work unit 007.

Descriptors: *Desalination, *Water reuse, *Bactericides, *Rubber, Distillation, Taste, Toxicity, Recirculated water, Reclaimed water.
Identifiers: Biocidal rubber compounds.

An assessment was made of the bactericidal efficacy of 17 biologically active elastomeric materials against 7 genera of microorganisms under static and varying dynamic conditions. A test cell and a laboratory model of a vacuum distillation water reclamation system used in the study are described. Compounds showing the greatest overall effectiveness in buffered distilled water solutions and in urine are delineated. Taste thresholds and data on rat feeding experiments using one of the biocidal agents are included. (Knapp-USGS)
W70-02059

A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS,
Aerojet-General Corp., El Monte, Calif.
G. A. Fluke.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC, 20402 -- Price $1.25. Office of Saline Water Research and Development Progress Report No 428, May 1969. 50 p, 6 tab, 24 fig, 1 append. OSW Contract No 14-01-0001-1329.

Descriptors: *Membranes, *Reverse osmosis, *Desalination processes, Costs, Cost analysis, Porous media, Sulfates, Chlorides, Sea water, Design, Permeability.
Identifiers: Membrane cells, Plate-and-frame reverse osmosis, Collection grooves.

Design concepts to reduce the cost of reverse osmosis devices were tested. Cost reduction in plate-and-frame reverse osmosis can be achieved by a lateral permeation of product water through a porous substrate. Materials that provide adequate permeation of product water parallel to a structural member plate eliminate the need for collection grooves. A high sulfate, low chloride retention membrane was used to test the concepts. In a synthetic sea water a 'blend' type high chloride retention membrane was used. The field replacement of membrane was successfully accomplished in a 'weeping cell' configuration apparatus. Externally mounted membranes with tubular supports were found to have the best configuration for porous substrate use. (Carstea-USGS)
W70-02063

EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
Nebraska Univ., Lincoln. Dept. of Chemical Engineering.
Dennis D. Kos, and Luh C. Tao.
I and EC Prod Res and Develop, Vol 8, No 3, p 306-309, Sept 1969. 4 p, 2 fig, 1 tab, 10 ref. OWRR Project A-010-NEB.

Descriptors: *Desalination processes, *Distillation, *Coatings, *Boilers, *Scaling, Calcium sulfate, Descaling, Protective coatings, Films, Inhibitors, Linings, Plastics, Thin films.
Identifiers: Polyfluorocarbon scale-resistant tube coatings.

Experiments showed that coatings of polyfluorocarbon less than 0.001 inch thick on tube surfaces deterred scaling in evaporators with continuous feed of calcium sulfate solutions. Coated tube heat-transfer coefficients varied from 0.76 to 3.54 times those of uncoated tubes with the best results in the most concentrated solutions. Coatings appeared durable at the end of the longest (33 hr) run. Results are tabulated and shown graphically. (Knapp-USGS)
W70-02068

SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
Alaska Univ., College. Arctic Environmental Engineering Lab.; and Alaska Univ., College. Inst. of Water Resources.
H. R. Peyton, P. R. Johnson, and C. E. Behlke.
Univ Alaska Arctic Environ Eng Lab Res Rep No 4, Sept 1967. 30 p, 18 fig, 3 tab, 6 ref. OWRR Proj No B-001-ALAS.

Descriptors: *Desalination, *Construction materials, *Ice, *Freezing, *Sea water, Cold regions, Costs, Sea ice, Cryogenics, Crystal growth, Crystallization, Desalination processes, Construction.
Identifiers: Ice construction engineering.

In cold regions, desalination by freezing sea water was studied as a possible economical process. Power requirements are greatly lowered by using low winter temperatures to freeze water and using the summer's adequate solar energy to remelt it. The use of frozen sea water as a structural material was also studied. At high enough latitudes, summer ablation can be controlled to the point that major structures made of ice will last through the summer. Material costs should be low. (Knapp-USGS)
W70-02113

RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
Aerojet-General Corp., Sacramento, Calif.
David O. DePree, and Herman H. Weyland.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC, 20402 -- Price $0.60. Office of Saline Water Research and Development Progress Report No 435, 1969. 54 p, 8 tab, 16 fig. OSW Contract No 14-01-0001-1692.

Descriptors: *Chelation, *Brines, *Desalination processes, Metals, Salts, Evaportation, Resins, Cation exchange, Ion exchange, Potassium, Sodium, Magnesium, Calcium, Brackish water, Economics, Dissolved solids.
Identifiers: *Metal recovery, Methanol.

Separation of salts from concentrated brines by chelation processes can be conducted without the high energy input required by evaporation processes. Chelation is highly selective so that metal ions with economic value can be separared in relatively pure form. Regeneration of cation exchange resins with chelate solutions and separation of potassium, sodium, magnesium and calcium has been demonstrated. Concentration of metal chelate influences the recovery of metal salts by acidification of the chelate solutions. Desalination of brackish water containing 2000 ppm total dissolved solids was used to estimate the economics of an ion exchange desalination operation. These are several advantages of the regeneration process: (1) water-swollen resin has the highest rate of regeneration; (2) the most effective solvent and also the cheapest was methanol; (3) the polyvalent ions from the ion exchange resins are not removed by the chelating agents found effective in removing monovalent ions, and (4) Anhydrous HCL is used to precipitate metal salts from methanol solutions of the chelates. (Carstea-USGS)
W70-02116

DESALINATION RESEARCH AT OAK RIDGE,
Oak Ridge National Lab., Tenn.
K. A. Kraus, R. J. Raridon, J. S. Johnson, E. G. Bohlmann, and F. A. Posey.
Available from Superintendent of Documents, US Government Printing Office, Washington, DC, 20402 -- Price $0.60. Office of Saline Water Research and Development Progress Report No 468, August 1969. 53 p, 95 ref. OSW Contract No 14-01-0001-937.

Descriptors: *Desalination, *Research and development, *Bibliographies, *Desalination processes, *Abstracts, Publications, Reviews, Surveys.
Identifiers: Oak Ridge National Laboratory, U.S. Atomic Energy Commission.

A bibliography and abstracts are presented of 95 open literature publications issued by the Oak Ridge National Laboratory, Water Research Pro-

gram from 1962 through December 1968. The Oak Ridge National Laboratory had been conducting a research program in desalination under an interagency agreement between the U.S. Department of the Interior and the U.S. Atomic Energy Commission. The acquisition of experimental data and the development of fundamental theory for a better understanding of desalination systems were the main objectives of the research program. The list of publications is arranged alphabetically by first author for each year and each publication includes the authors, title, literature reference and an abstract. Subject matter and author indices are also included. (Carstea-USGS)
W70-02117

EVAPORATION FOR DESALINATION,
Polytechnic Inst. of Brooklyn, N.Y.
Donald F. Othmer.
Desalination, Vol 6, No 1, p 13-24, Apr 1969. 12 p, 5 fig, 9 ref.

Descriptors: *Demineralization, *Desalination, *Evaporation, Brines, Vaporization, Pressure, Sea water, Fresh water, Costs, Capital costs, Investment, Heated water, Steam, Preheating, Heat transfer, Economies.
Identifiers: *Multistage flash distill, High temperature, Flash evaporation, Heat exchange, Heat sources, Cost savings.

Multistage flash (MSF) evaporation may produce 10 pounds of water per pound of steam, the so-called gain ratio. Several MSF units in a multi-effect series give twice this gain ratio at a large increase in plant cost. Variations in MSF increase the gain ratio substantially without increase, or with a decrease, of plant cost. First, the prime or brine heater, if used also as an evaporator to supply vapors to a half-stage above the No. 1 stage on the condensing-cooling side, may save 4 to 25% of required heat, depending on the number of stages. In large plants, this could produce many gallons more water per day without added heat cost or without increasing plant cost per unit of product. Second, the vapor reheat MSF system condenses vapors in direct contact with sprays of recycling fresh water in open flow, using no heat transfer surfaces, the largest cost item of an evaporator. Heat may be supplied by: (1) submerged combustion of a fluid fuel; (2) steam; (3) mechanical vapor compression; and (4) absorption-regeneration vapor compression. Over 50% saving of thermal or mechanical energy used may be possible by (3) and (4). Third, vapor reheat MSF may have the gain ratio increased 5 to 10% by changing the usual flows and heat reject from a lower stage. Conventional MSF may also benefit. (USBR)
W70-02158

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.

Water and Sewage Works, Vol 116, 1969 Ref No, p R32-R34, Nov 28, 1969. 3 p, 3 fig, 5 ref.

Descriptors: *Water wells, *Beaches, *Sea water, *Induced infiltration, *Desalination plants, Water supply, Filtration, Permeability, Water yield, Groundwater movement, Transmissivity, Aquifers.
Identifiers: Sea water wells, Aquifer testing, Pumping tests.

Naturally filtered sea water in moderately large quantities for use as feed water for salt water conversion plants can be pumped from multiple-well systems installed in beach sand near or below high tide. The saturated beach sand constitutes a water-table aquifer that is replenished by the ocean. Wells are less likely to be damaged by storms than is an open-water intake structure. Where the thickness of beach sand is adequate, the cost of a well system will be less than that of a conventional intake, except for situations where unusually large quantities of sea water are needed. Static water levels and fluctuations of water levels prior to pumping tests must be measured and plotted for several tidal intervals, so that changes by the tide can be taken into account in calculating the hydraulic characteristics of the beach sand to obtain well yields. (Knapp-USGS)
W70-02290

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
Westinghouse Electric Corp., Pittsburgh, Pa. Heat Transfer Div.
Robert A. Baker, Jr.
Water and Sewage Works, Vol 116, 1969 Ref No, p R4-R16, Nov 28, 1969. 13 p, 10 fig.

Descriptors: *Desalination, *Desalination processes, *Desalination plants, *Reviews, Distillation, Reverse osmosis, Costs, Economics, Economies of Scale.
Identifiers: Key West (Fla), Kuwait.

The present state of desalination technology and economics are briefly reviewed. The most commonly used technique is flash distillation. The Key West plant is the largest and most efficient of this type in operation. It uses only 68 btu per lb of output. Construction cost was $4,056,000, and fresh water costs 86 cents per thousand gallons to produce. Combining desalination with power production can lower costs below those of single-purpose plants in many cases. Other techniques reviewed are experimental reverse osmosis plants for desalination, tertiary treatment, and water reuse. (Knapp-USGS)
W70-02291

3B. Water Yield Improvement

WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
Geological Survey, Washington, D.C.
Raymond O. Plebuch, and Marion S. Hines.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402. Geol Surv Water-Supply Pap 1879-A, p A1-A32, 1969. 32 p, 2 fig, 1 plate, 8 tab, 27 ref.

Descriptors: *Water resources, *Arkansas, *Groundwater, *Surface waters, Reservoirs, Streamflow, Water wells, Aquifers, Water quality, Water yield, Hydrologic data, Data collections, Water utilization, Hydrogeology, Water resources development.
Identifiers: *Clark County (Ark), Cleveland County (Ark), Dallas County (Ark).

Clark, Cleveland, and Dallas counties constitute an area of 2,151 square miles in south-central Arkansas. The area is drained by the Ouachita, Saline, and Little Missouri Rivers and their tributaries. The amount of water available for use can be increased by the construction of reservoirs. The average surface-water yield in the area is about 1/4 cubic feet per second per square mile, or a total of about 3,000 cfs. Generally, the water quality is good; but water from some of the streams, particularly from the smaller tributaries, may require treatment for excessive iron content and high color. The consolidated rocks in the Interior Highlands generally yield less than 10 gpm to wells, precluding the development of large municipal or industrial groundwater supplies in that area. The formations of Tertiary age offer the best possibilities for groundwater, particularly in Dallas and Cleveland Counties. The Sparta Sand is the best aquifer in the project area, particularly east of central Dallas County. Well yields of 700 gallons per minute or more are possible. The deposits of Quaternary age are thin and generally suitable only for domestic supplies. Total water use in the project area in 1965 was about 0.6 million gallons per day since 1960. Slightly more than one-half this amount was derived from surface-water sources. Total water use in the area in 1967 was insignificant compared with the total water available. (Knapp-USGS)
W70-02055

PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
Geological Survey, Honolulu, Hawaii.
George Yamanaga, and C. J. Huxel.
Hawaii Div of Water and Land Develop Circ c51, Feb 1969. 47 p, 16 fig, 14 tab, 13 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Hawaii, Streamflow, Base flow, Aquifers, Water resources development, Water wells, Water levels, Water quality, Saline water intrusion, Water yield, Water storage.
Identifiers: Lahaina, Maui (Hawaii).

The Lahaina District, Hawaii consists of the western part of the West Maui volcanic dome. Numerous intersecting dikes in the central part of the dome, where rainfall is high, impound a large high-level groundwater body, oval-shaped in plan. All perennial streams in the Lahaina District derive their dry-weather flow (base flow) from this high-level water body. The aggregate low flow of streams in the District exceeds 25 mgd. Basal groundwater occurs in a peripheral belt surrounding the area of high-level water. Pumpage from the basal-water body averages about 50 mgd. The fresh-water lens is thin near the shore. Heavy concentrated pumping from wells and shafts, even as much as 3,000 ft inland, results in large, though usually temporary, increases in salinity. In general, fresher water is found farther inland, nearer the high-level water. Leakage of high-level water through confining boundary dikes is probably a major recharge source for the basal-water body. The high-level water body appears to be the most promising source that might be tapped if additional domestic water is needed. (Knapp-USGS)
W70-02065

GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
Tennessee Dept. of Conservation, Nashville. Div. of Water Resources; and Geological Survey, Nashville, Tenn.
John M. Wilson, and James H. Criner.
Tenn Dep Conserv, Water Resources Div Rep, 1969. 49 p, 12 fig, 1 plate, 13 ref, 5 append.

Descriptors: *Hydrogeology, *Groundwater, *Water quality, *Tennessee, Water wells, Water yield, Water utilization, Groundwater movement, Water pollution sources, Water levels, Hydrologic data, Data collections, Aquifers, Water level fluctuations.
Identifiers: Henry County, Weakley County (Tenn).

The water-yielding potential and water quality of the shallow aquifers in Henry and Weakley Counties, Tennessee are discussed. Although the geologic character of the shallow aquifers is quite different from place to place, sufficient quantities of water for domestic and farm use are universally available. Supplies adequate for municipal and industrial use are also available in much of the area from one of the three major artesian aquifers. The use of groundwater in the area in 1967 is estimated at 5 mgd. Rural residents and farmers account for about one-third of the total. The rate of withdrawal could be increased a hundred percent without ill effects. The dissolved iron content of the shallow groundwater supplies is commonly troublesome, but this problem can be solved by corrective treatment to remove the excess iron prior to use. Except for the undesirable high dissolved iron content of some supplies, the chemical quality of the groundwater in the report area is excellent for most uses without treatment. Bacterial contamination was noted in most large diameter, concrete-cased wells. Unsafe well design and construction practices are considered to be the chief cause of this type of contamination. (Knapp-USGS)
W70-02071

DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
Geological Survey, Santa Fe, N. Mex.; and Geological Survey, Albuquerque, N. Mex.
William D. Purtymun, and James B. Cooper.
Geol Surv Res 1969, Prof Pap 650-B, p B149-B153, 1969. 5 p, 2 fig, 3 tab, 4 ref.

Descriptors: *Water supply, *Groundwater, *Aquifers, *New Mexico, Water yield, Water wells, Hydrogeology, Permeability, Hydrologic data.
Identifiers: *Los Alamos (New Mexico).

The Pajarito Mesa well field, completed in 1966 on the Pajarito Plateau, contributed 37% of the total water supply to Los Alamos in 1967. Two wells in the field are capable of yields of 1,400 gallons per minute each. This yield is about three times that of any of the other 13 supply wells in the water-supply system. The high yield of the two wells is attributed to the occurrence of coarse volcanic debris and arkosic sediment in the Puye and Tesuque Formations of the Santa Fe Group that make up the main aquifer beneath the Pajarito Plateau. (Knapp-USGS)
W70-02076

OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
Geological Survey, Trenton, N.J.; and New Jersey State Dept. of Conservation and Economic Development. Water Policy and Supply Div.
John Vecchioli, Louis D. Carswell, and Haig F. Kasabach.
Geol Surv Res 1969, Prof Pap 650-B, p B154-B157, 1969. 4 p, 5 fig, 2 ref.

Descriptors: *Water wells, *Aquifers, *Groundwater movement, *New Jersey, Hydrogeology, Hydrologic data, Water yield, Permeability, Transmissivity.
Identifiers: *Trenton (NJ), Brunswick Shale.

Measurements of yield made during the drilling of 13 wells in the Brunswick Shale of Late Triassic age near Trenton, N. J., indicate that groundwater occurs mainly in discrete zones controlled by bedding. Productivity of a well may be dependent on only one or on several zones; however, no relation was apparent between yield and the number of zones penetrated. Movement of water under pumping conditions, and presumably under natural conditions, is preferentially along strike, as indicated by drawdown observations made during several pumping tests. Wells situated along strike and thus tapping common producing zones had a greater drawdown than wells equidistant in transverse directions. Knowledge of a preferential direction of water movement in the Brunswick Shale is invaluable when locating a well with respect to a potential source of pollution or in attempting to minimize well interference. (Knapp-USGS)
W70-02077

EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
Geological Survey, Huron, S. Dak.
Neil C. Koch.
Geol Surv Res 1969, Prof Pap 650-B, p B169-B173, 1969. 5 p, 4 fig, 2 ref.

Descriptors: *Surface-groundwater relationships, *South Dakota, *Reservoir storage, *Aquifers, *Water levels, Recharge, Groundwater movement, Induced infiltration, Alluvium, Missouri River, Hydrographs.
Identifiers: *Oahe Reservoir (S Dak).

The filling of the Oahe Reservoir, which raised the reservoir surface west of Pollock, S. Dak., about 47 feet by December 1967, has produced a rise in the piezometric surface in a large buried artesian aquifer of glacial origin. The rise resulted in water-level rises of 34, 22, 20, and 17 feet in wells about 4, 11 1/2, 16 1/2, and 18 miles, respectively, from the reservoir. The piezometric surface 4 miles from the reservoir was about 13 feet above reservoir level as of December 1967. The aquifer is practically undeveloped. If development of the aquifer lowers the level of the piezometric surface below that of the reservoir surface, the hydraulic gradient would reverse and induce recharge from the Oahe Reservoir. This would provide a nearly unlimited water supply and would eventually improve the quality of water in the aquifer. (Knapp-USGS)
W70-02081

A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
Texas A and M Univ., College Station.
Samuel Erick Baker.
Tex Water Develop Board Rep No 96, June 1969. 79 p, 4 fig, 7 tab, 21 ref, 3 append.

Descriptors: *Precipitable water, *Texas, *Meteorology, *Synoptic analysis, Statistical methods, Precipitation (Atmospheric), Cloud seeding, Arid lands, Weather modification.
Identifiers: West Texas, Eastern New Mexico.

Total depth of precipitable water for 5 stations in western Texas and eastern New Mexico is studied to determine a frequency distribution which will describe this climatic element. A conclusion evolving from the study is that a normal distribution adjusted for skewness and kurtosis may be used to describe adequately the frequency distribution presented by the observed depths of precipitable water grouped by pentads. An annual series of the yearly maximum depth of precipitable water from each of the 5 stations is plotted vs the recurrence interval. A Gumbel distribution is fitted to each annual series providing a means of determining the return periods of extreme depths of precipitable water. The probabilities of precipitable water depths are tabulated and shown by graphs. The data may be used to predict the potential yield from cloud seeding programs to increase regional water yield. (Knapp-USGS)
W70-02096

WATER USE BY SALTCEDAR WITH MANY FACTORS,
Geological Survey, Lubbock, Tex.
T. E. A. van Hylckama.
Pap, Geol Surv, Lubbock, Tex, Mar 1969. 22 p, 7 fig, 4 tab, 11 ref.

Descriptors: *Tamarisk, *Water utilization, *Phreatophytes, Electrical conductance, Arid lands, *Consumptive use, Evapotranspiration, Arizona, Salinity, Tanks (Containers), Evaporation, Transpiration, Soil moisture, Depth, Water table, Saline water, Plant growth.
Identifiers: Evapotranspirometers, Gila River (Ariz), Hydrophytes.

During 6 yr of observations on water use by saltcedar on the Gila River, Ariz., using evapotranspirometers (tanks), the following conclusions were reached: (1) the quantity of water used by evaporation or transpiration depends on depth to ground water in the tanks and on salinity of the soil moisture; (2) in 2 tanks the saltcedar was thinned out in the early spring to half its original density when 3 to 4 m high. In the tank with good-quality water, the water use dropped 30%, but within 2 mo was only 5% less than the water used in the control tank. In the other tank with more saline soil moisture, water use dropped 35% and after 2 mo was still 25% less than the water used in the control tank; (3) in 2 other tanks, the saltcedar in the early spring was cut to knee height. In the low-conductivity tank, the water use dropped 70%, but after 2 mo was only 30% less than the water used in the control tank. In the tank with saline water, water use dropped 90% and after 2 mo was still 60% less than the water used in the control tank; (4) under conditions of low salinity of soil moisture, saltcedar sprouts grow faster than when more saline conditions prevail. The difference in growth characteristics between control and thinned-out stands is not significant. (USBR)
W70-02134

RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
Ukrainskii Nauchno-Issledovatelskii Institut Lesnogo Khoziaistva i Agrolesomelioratsii, Kharkov (USSR).
For primary bibliographic entry see Field 02A.
W70-02228

WATER EVAPORATION SUPPRESSION,
Virginia Univ., Charlottesville.
John L. Gainer, James T. Beard, and Robert R. Thomas.
Available from the Clearinghouse as PB-188 498, $3.00 in paper copy, $0.65 in microfiche. Virginia Water Resources Research Center Bulletin 27, Aug 1969. 23 p, 3 tab, 6 fig, 13 ref. OWRR Project A-019-VA.

Descriptors: *Evaporation, *Diffusion, *Solar radiation, *Infrared radiation, *Monomolecular films, Mass transfer, Evaporation control, Water conservation, Water loss, Energy, Thin films, Films, Surfactants, Molecular diffusion, Diffusivity, Thermal pollution, Air water interface.
Identifiers: *Solar reflection, Reflection, Water reflection, Reflectance, Reflectivity.

A theory is presented which relates the diffusion of water through a liquid monolayer to the monolayer surface pressure. This enables quick evaluation of a monolayer's ability to retard evaporation. The evaporation process is driven by solar energy, which is absorbed at the water surface. Placing a reflecting film on the surface would be one method of evaporation suppression. As yellow materials reflect at wave lengths where solar energy has its peak intensity, yellow monolayers and dyed monolayers were studied experimentally. No materials were found to both form a stable monolayer and to significantly improve the reflectivity of the water surface. A yellow silicone oil film on a water surface was studied after it was found experimentally to reflect solar energy about 1.7 times better than a plain water surface. Although it sometimes does not form a monolayer, it did reduce evaporation by diffusion. When spread over a water surface, it reduced evaporation by a minimum 10%, and it reduced evaporation by a minimum 15% when spread over a lenoleic acid monolayer. In addition, the film was found to be extremely difficult to remove from a water surface. This is a real advantage when one considers the need to constantly resupply monolayers presently used in evaporation suppression applications.
W70-02276

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
Virginia Univ., Charlottesville.
James T. Beard, and David K. Hollen.
Available from the Clearinghouse as PB-188 499, $3.00 in paper copy, $0.65 in microfiche. Virginia Water Resources Research Center Bulletin 30, Aug 1969. 26 p, 3 tab, 4 fig, 23 ref. OWRR Project A-019-VA.

Descriptors: *Evaporation, *Evaporation control, *Solar radiation, *Monomolecular films, *Water loss, *Thin films, *Energy budget, Energy, Heat transfer, Mass transfer, Air water interface, Water conservation, Infrared radiation, Water loss, Water, Reservoirs, Films, Surfactants, Thermal pollution, Temperature.
Identifiers: *Solar reflection, Reflection, Water reflection, Reflectance, Reflectivity.

Reservoir evaporation may be reduced by increasing the reflectance of solar energy by the water surface. Such a change in reflectance will require surface modifications such as application of a special

surface film or monolayer which has good reflecting properties. The amount of evaporation suppression will depend also on the changes in diffusion coefficient and shear stress which will accompany surface modifications. The transient energy equation was applied to an element of a water surface. Numerical methods were used to solve the equation with the aid of a digital computer. An evaluation of the various energy terms was required for this analysis. These terms included: convection heat transfer, absorbed solar energy, long-wave radiant energy, energy associated with evaporation, and the transient storage of energy. The analytical model gave an average evaporation suppression by cetyl alcohol to be 22.6%. This is consistent with the experimental work of Crow at Oklahoma State University, who indicated a 25% reduction. Results for monolayers with hypothetical reflectance properties and with the diffusion properties of a cetyl alcohol monolayer showed average evaporation reductions of 25% to 45%, depending on the reflection properties selected.
W70-02277

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-02322

3C. Use of Water of Impaired Quality

ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
South Dakota State Univ., Brookings. Dept. of Economics.
Arthur J. Matson, Norman G. Giebink, and Louis C. Rentschler.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $1.50. Office Saline Water Res and Develop Progr Rep No 463, Oct 1969. 191 p, 1 fig, 42 tab, 37 ref. OSW Grant No 14-01-0001-463.

Descriptors: *Water quality, *Municipal water, *Desalination, *South Dakota, Water costs, Economic impact, Fresh water, Brackish water, Pilot plants, Statistical methods, Research and development.
Identifiers: *Webster (S Dak), Northern Great Plains.

The municipal use of water before and after conversion of brackish water into fresh water was studied in several towns in NE South Dakota. The economical aspects of saline water conversion, water use, and water supply are discussed. A brackish water conversion demonstration plant supplied the Webster municipal system with water that could be taken as a standard for comparison. However, there was a lack of general agreement of what constituted good water. Statistical analysis was applied to identify uses of water in relation to water quality. Water quality was recognized as one factor in the total economic growth of this region in the Northern Great Plains. Additional research is recommended to establish relationships useful in decisions regarding investment in water quality improvement. (Carstea-USGS)
W70-02051

EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 05C.
W70-02093

EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
South Dakota State Univ., Brookings.
John M. Madden.
Available from the Clearinghouse as PB-188 503, $3.00 in paper copy, $0.65 in microfiche. Completion Report, Nov 1969. 55 p, 18 tab, 18 fig, 7 ref, 3 append. OWRR Project A-011-SDAK.

Descriptors: Irrigation engineering, *Saline soils, Soil chemical properties, Soil analysis, *Irrigation effects, Irrigation water, Soil physical properties.

The purpose of this research was to determine the effects of marginal quality irrigation water on the salt and alkali accumulation in soils peculiar to the sub-humid and semi-arid climate existing in South Dakota. Soil samples were taken from the fields of eleven cooperating farmers and analyzed to determine the exchangeable-sodium-percentage, SAR, electrical conductivity, pH, soluble carbonates, alkalinity, and saturation percentage. The irrigation waters were sampled and analyzed to determine the SAR, pH, electrical conductivity, residual sodium carbonate, and total soluble salts. The above samples were taken periodically for the duration of the project. Cropping practices, amounts of irrigation water applied, and rainfall were also recorded. The resulting data were analyzed to determine the amounts and rates of salt and alkali accumulation. Equations were also derived with the objective of estimating the exchangeable-sodium-percentage of the soil from determinations made on the saturation paste and its extract.
W70-02280

CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
V. M. Borovskiy.
Vestnik Akademii Nauk SSSR, No 9, p 85-90, Sept 1969. 3 tab, 5 ref.

Descriptors: *Soils, *Salinity, *Irrigation, *Irrigation water, Rivers, Climates, Geology, Mineralogy, Surface runoff, Groundwater, Topography, Solubility, Water balance, Deserts, Water levels.
Identifiers: *USSR, Kazakh SSR, Syr-Darya delta.

Salt content of the soils and groundwaters of the Amu Darya and Syr Darya River deltas was investigated by using detailed sampling. In all cases where a dynamic soil-groundwater intercommunication system is present, the groundwaters are characterized by greater salt contents than the soils. Salt-marsh areas are characterized by having no more than 6% salt content in soil and groundwater; however, in using groundwater for irrigation it should be noted that chlorides in groundwater are more toxic to plants than sulfate in soil water. (Gabriel-USGS)
W70-02418

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
I. M. Dvorov.
Vestnik Adademii Nauk SSSR, No 9, p 127-129, Sept 1969.

Descriptors: *Thermal water, *Thermal power, *Water temperature, *Water utilization, *Conferences, Instrumentation, Electric powerplants, Energy budget, Agricultural engineering, Discharge (Water), Trace elements, Mining, Irrigation water.
Identifiers: *USSR.

A brief outline of the results of the geothermal conference on the 'Thermal Waters of the USSR and the Prospects of Their Utilization' is given. Large resources of thermal waters are present in Kamchatka, the Magadan region, the Transbaikal Lake area, and other areas of the USSR. Thermal waters of 40 to 70 deg C can be utilized for agricultural purposes. (Gabriel-USGS)
W70-02419

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
Volgograd Agricultural Inst. (USSR).
V. F. Shubin.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol I, p 405-413, 1968. 2 tab.

Descriptors: *Wastes, *Arid lands, *Irrigation practices, *Water reuse, *Water pollution treatment, Alkaline soils, Soil chemical properties, Water pollution sources, Irrigable land, Water utilization, Water conservation.
Identifiers: *USSR.

The author reports of experimental use of industrial and urban wastes to irrigate mildly alkaline soils in the semiarid lower Volga in the USSR. The waters used were those wastes not emitted from chemical industrial processes such as those from synthetic rubber plants. The author concludes that it is highly desirable to run pilot tests with the waste waters and soils of any given region to develop suitable irrigation practices before embarking on large scale irrigation projects. The waste waters were found useful for irrigation and fertilizing and these uses also helped purify the waters. Food, fiber, oil-producing, fruit and tobacco crops were successful. If the waste waters were free of toxic properties, it was found that they could be used if they were properly mixed with sewage and conditionally cleaned waters. No problem of contamination of rivers, lakes, ponds and other natural water resources was found. (Crouse-Arizona)
W70-02424

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
For primary bibliographic entry see Field 02G.
W70-02425

THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02G.
W70-02426

QUALITY OF IRRIGATION WATER,
Indian Council of Agricultural Research, New Delhi; and Punjab Agriculture University, Hissar (India).
J. S. Kanwar, and B. S. Kanwar.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol I, p 391-403, 1968. 5 tab, 1 fig, 24 ref.

Descriptors: *Water quality, *Irrigation water, Soil chemical properties, *Saline water, *Sodium, Crop response, Soil-water-plant relationships, Subsurface waters, Wheat, Germination, Groundwater, Corn (Field), Arid lands, Adsorption, Cation adsorption, Salts, Semiarid climates, Water chemistry.
Identifiers: *India.

When determining quality of water for irrigation, the nature and property of soils, crop to be grown and climate should be considered as well as chemical composition of the water. Although sub-soil waters in arid areas frequently contain substantial amounts of salts they are sometimes used successfully for irrigation when other conditions are suitable. The authors report a randomized block experiment using waters of 4 salinity levels and 4 SAR (sodium absorption ratios). Two crops of maize fodder and 1 of wheat were grown in succession. A total of 90 inches of irrigation water was applied for the three crops. Effects of different cation compositions in the irrigation water were also studied. Yields of all crops decreased as salt concentration in water increased. When the salt level was raised

to 200 m-equiv./litre, the second and third crops could not germinate. Increased SAR did not have so great an effect on yield. It was concluded that the nature of the soil and cumulative effect of a given amount of saline water on soil determines the effect on crops. The authors endorse use of triangular diagram methods considering soil, water and plant in determining water quality for a particular irrigation use. (Crouse-Arizona)
W70-02429

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
All-Union Scientific and Research Inst. of Hydrotechnics and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 05G.
W70-02432

SALTING IN IRRIGATION AREAS,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Soils.
For primary bibliographic entry see Field 02G.
W70-02433

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
For primary bibliographic entry see Field 02G.
W70-02434

ATRIPLEX POLYCARPA: II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
California Univ., Riverside. Dept. of Agronomy; and California Univ., Riverside. Dept. of Soils and Plant Nutrition.
For primary bibliographic entry see Field 02I.
W70-02438

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
Akademiya Nauk SSSR, Moscow. Pochvennyi Institut.
For primary bibliographic entry see Field 02G.
W70-02439

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
All-Union Scientific-Research Inst. of Hydrotechnics and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 02G.
W70-02441

3D. Conservation in Domestic and Municipal Use

PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
Geological Survey, Jacksonville, Fla.
G. W. Leve, and D. A. Goolsby.
Florida State Board of Conserv, Div of Geol Inform Circ No 58, 1969. 37 p, 9 fig, 14 tab, 6 ref.

Descriptors: *Water supply, *Water yield, *Water utilization, *Florida, Surface waters, Groundwater, Water wells, Aquifers, Water levels, Water quality, Hydrogeology, Date collections, Hydrologic data, Water yield, Municipal water, Industrial water, Urbanization.
Identifiers: Jacksonville (Fla).

Large quantities of water are available both from numerous surface streams and from underground aquifers in the Jacksonville, Florida area; however, the water in most of the surface streams is brackish at least part of the year and is used for limited industrial purposes. The potable water supplies in the area are obtained from 3 aquifers: surficial sand beds; limestone, shell and sand beds between 50 to 150 ft below the surface; and limestone and dolomite beds more than 300 to 600 ft below the surface and about 1,600 ft thick (the Floridan aquifer). The city of Jacksonville municipal water utility pumped an average of about 36 mgd in 1966 from 47 wells drilled into the Floridan aquifer. The municipal utilities of Jacksonville Beach, Neptune Beach, and Atlantic Beach pumped a total average of about 3 mgd in 1966 from 11 wells in the Floridan aquifer. Eighty-nine large, privately and corporately owned water utilities in the area produced a total average of about 22 mgd in 1966 from 105 wells in the Floridan aquifer. Two large naval bases produced a total average of about 5.5 mgd in 1966 from 8 wells in the Floridan aquifer. Private wells yielded an estimated 10 to 25 mgd from the limestone, shell and sand aquifer and about 5 mgd from the Floridan aquifer in 1966. The average water withdrawals by all of the municipal and privately and corporately owned water utilities in the area increased from 27 mgd in 1947 to 60 mgd in 1966. (Knapp-USGS)
W70-02092

TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
Stanford Research Inst., Menlo Park, Calif.
For primary bibliographic entry see Field 06D.
W70-02267

3E. Conservation in Industry

ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
Bureau of Reclamation, Washington, D.C.
Floyd E. Dominy.
Pap, 15th Annu Rocky Mt Miner Law Inst, Vail, Colo, July 1969. 43 p, 7 fig, 2 tab, 20 ref.

Descriptors: Natural resources, *Water supply, Water quality, Water resources, *Industrial water, *Municipal water, Irrigation water, Costs, Water consumption, Interest, Water resources development, Population, Multiple-purpose projects, Repayment contracts, Population growth, Water requirements, Legislation, Water delivery, Water demand, Bibliographies.
Identifiers: *Water supply forecasting, Repayment, Operation and maintenance costs.

Water is a vital prerequisite to progress because existing industries cannot expand and new industries cannot develop in areas lacking an adequate water supply. Federal Reclamation projects have been designed to help meet these needs and play an increasingly important role in supplying future needs. National philosophy has been that all Reclamation project costs for the purpose of irrigation, power, and municipal and industrial supply should be repaid in full. Repayment of all reimbursable project costs and operation and maintenance costs is a responsibility of project beneficiaries. Municipal and industrial water supply costs are repaid in 50 yr (with interest) by revenues from water users. Many western cities rely on water supplies developed or being developed by Reclamation, and demand is increasing with population expansion. Municipal and industrial water demands in the western water regions for a population of over 160 million by the yr 2020 are estimated to increase from 7.8 trillion gal. in 1965 to 62.1 trillion gal. in 2020. Future developments and the possibilities of tapping new sources such as weather modification make the physical potential promising for community and industrial development in connection with water supplies from Reclamation projects. (USBR)
W70-02167

3F. Conservation in Agriculture

EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
Nebraska Univ., Lincoln.
Norman J. Rosenberg.
Agron J, Vol 61, No 4, p 557-561, July-Aug 1969. 5 p, 3 tab, 27 ref.

Descriptors: *Evaporation, *Condensation, Soils, *Irrigated land, Dew, Great Plains, Soil science, *Lysimeters, Radiation, Nocturnal, Agronomy, Bibliographies, Advection, Solar radiation, Energy balance.
Identifiers: Net radiometer, Penman method, Potential evaporation, Van Bavel method.

Evaporation from bare Sharpsburg sandy clay loam was measured using precision weighing lysimeters at Mead, Nebr, during summer and fall of 1966; many drying cycles were included. Maximum daily evaporation was about 9 mm/day in Aug and about 3 mm/day in late Oct. The ration evaporation/net radiation was frequently greater than unity, especially when the lysimeters and a one-ha area surrounding them were visibly wet and the surface of the adjacent fields was dry. A significant advectional contribution of energy is indicated. Nocturnal evaporation accounted for 10 to 50% of the total daily evaporation, the greater proportions occurring in fall. Dew was detected almost every morning. A maximum dew deposition of about 0.5 mm was measured. The Penman method yielded lower estimates of bare soil evaporation than the van Bavel combination method. Both types of estimates varied from lysimetrically measured evaporation from 3 to 50% on a daily basis. (USBR)
W70-02144

CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
Gidrometeorologicheskii Institut, Odessa (USSR).
G. I. Shvebs.
Leningrad, Gosudarstvennyi Gidrologicheskii Inst, Sbornik Rabot po Gidrologii, No 7, p 122-126, 1967. 5 p, 1 tab, 5 ref.

Descriptors: *Stubble mulching, *Water conservation, *Mulching, *Erosion control, Agriculture, Rainfall, Soils, Snowmelt, Climates, Infiltration, Filtration, Porosity, Velocity, Water circulation, Soil erosion, Model studies, Forests.
Identifiers: *USSR, Patch-stubble mulching.

Experimental mulching studies included covering patches of soil and ground with leaves, straw, paper, etc. to increase the infiltration of rain water and decrease soil erosion. The use of the patch-stubble mulching process shows its usefulness in controlling soil erosion and surface runoff. The same method can be successfully applied in forest areas for better control of infiltration and soil-erosion processes. (Gabriel-USGS)
W70-02229

THE SOILS OF THE TRUCIAL STATES: CLASSIFICATION AND CAPABILITY,
Durham Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 02G.
W70-02423

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
Commonwealth Scientific and Industrial Research Organization, Melbourne (Australia).
For primary bibliographic entry see Field 02G.
W70-02425

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
All-Union Scientific and Research Inst. of Hydrotechnics and Reclamation, Moscow (USSR).
For primary bibliographic entry see Field 05G.
W70-02432

CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
Arizona Univ., Tucson. Dept. of Watershed Management.
Ervin M. Schmutz, and Mohamad Fouad Al-Rabbat.
Progressive Agriculture in Arizona, Vol 21, No 5, p 3-5, Sept-Oct 1969. 3 p, 1 tab, 3 fig.

Descriptors: *Arid climates, *Range management, *Moisture stress, *Germination, *Compacted soils, Semiarid climates, Soil moisture, Wheat grasses, Arizona, Planting management, Range grasses, Seeds, Plant growth, Emerging vegetation stage, Drought tolerance.
Identifiers: *Winterfat, *Western U.S.

Successful seeding of arid and semi-arid rangelands is uncertain owing to low soil moisture and rapid evaporation of limited supplies. The authors report a greenhouse experiment to measure effects of soil moisture, planting depth and soil compaction on emergence and survival of crested wheatgrass (Agropyron desertorum) and winterfat (Eurotia lanata). Crested wheatgrass is a cool-season, drouth-tolerant bunchgrass introduced from Asia to the arid western U.S. Winterfat is a low-growing, cool-season shrub which makes its major growth in spring and summer. The study showed that crested wheatgrass should be planted at 0.5 inch depth and winterfat on or near the surface for best emergence under either favorable or moisture stress conditions. Soil compaction before planting increased emergence of winterfat but not of crested wheatgrass. Compaction after planting did not affect either species. (Crouse-Arizona)
W70-02435

DON'T STRESS YOUR WHEAT FOR WATER,
Arizona Univ., Tucson. Dept. of Agronomy.
A. D. Day, and Suhbawatr Intalap.
Progressive Agriculture in Arizona, Vol 21, No 5, p 8-10, 1969. 3 tab.

Descriptors: *Arid lands, *Arizona, *Moisture stress, *Wheat, *Irrigation efficiency, Agriculture, Agronomic crops, Plant growth, Water requirements, Soil-water-plant relationships, Crop response, Crop production, Rates of application, Soil moisture.

In arid regions water has a dominant influence on crop production. Farmers in irrigated areas are confronted with the problem of economical use of water. It is essential to know the optimum time at which to apply limited amounts of water to obtain maximum yields. In southern Arizona wheat is planted in November or December for harvesting in late spring. The authors report a randomized block design experiment to compare 4 irrigation treatments during the winter growing period. The most critical period for moisture in the growth of wheat was found to be the jointing stage. Plants stressed at jointing stage were shorter, flowered earlier, and were more likely to lodge or to produce a significantly lower volume of grain. Moisture stress at the dough stage also resulted in lower grain volume. (Crouse-Arizona)
W70-02436

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
Victoria State Rivers and Water Supply Commission (Australia).
For primary bibliographic entry see Field 02A.
W70-02046

FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Corps Eng Flood Plain Rep, Apr 1969. 48 p, 23 fig, 30 plate, 5 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Mojave River (Calif), San Bernardino County (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Mojave River, San Bernardino County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02085

FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
Corps of Engineers, Sacramento, Calif.

Prepared for El Dorado County. Corps Eng Flood Plain Rep, Oct 1969. 27 p, 11 fig, 11 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Lake Tahoe, Truckee River (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Upper Truckee River, South Lake Tahoe, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02086

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
Corps of Engineers, Los Angeles, Calif.

Prepared for Santa Barbara County Flood Control and Water Conserv Dist. Corps Eng Flood Plain Rep, Nov 1968. 33 p, 12 fig, 27 plate, 9 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Santa Ynez River (Calif), Santa Barbara County (Calif), Standard project flood, Intermediate regional flood.

Flooding of the Santa Ynez River, Santa Barbara County, California is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02087

FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
Corps of Engineers, St. Louis, Mo.

Corps Eng Flood Plain Rep, Dec 1968. 64 p, 22 fig, 17 plate, 18 tab.

Descriptors: *Floods, *Flood damage, *Missouri, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Flat River area (Mo), Standard project flood, Intermediate regional flood.

Flooding of the Flat River area, Missouri is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02088

FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
Corps of Engineers, Fairbanks, Alaska.

Corps Eng Flood Plain Rep, Nov 1967. 61 p, 19 fig, 26 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *Alaska, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: *Fairbanks (Alas), Chena River, Standard project flood, Intermediate regional flood.

Flooding of the Chena River, Fairbanks, Alaska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02089

SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
Geological Survey, Washington, D.C.
F. W. Meyer, and J. E. Hull.
Florida Dep Natur Resources, Bur of Geol Inform Circ No 59, 1969. 31 p, 13 fig, 1 tab, 4 ref.

Descriptors: *Seepage, *Lakes, *Canals, *Florida, Water levels, Groundwater movement, Transmissivity, Aquifers, Drainage, Water level fluctuations.
Identifiers: Lake Okeechobee (Fla).

Tests were made along Levee D-1 and the adjacent Levee D-1 borrow canal at the west side of Lake Okeechobee near Moore Haven, Florida, to determine the magnitude of the underseepage from the lake. By relating the groundwater gradients in the vicinity to the amount of pickup in a 3 1/2-mile reach of the L-D1 Canal, it was determined that the underseepage factor is about 0.9 cfs per mile per foot of head between the lake and the canal. The coefficient of transmissibility of the underlying materials is about 72,000 gpd/ft. The values are important in the design of a pumping station which will remove increased underseepage when the lake level is raised several feet. (Knapp-USGS)
W70-02095

ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
Ministry of Irrigation and Power, New Delhi (India).
K. C. Majumdar.
J Hydrol, Vol 7, No 1, p 86-97, Nov 1968. 12 p, 5 ref.

Descriptors: *Reservoir operation, *Streamflow forecasting, *Statistical methods, Flood control, Water storage, Water management (Applied), Probability, Reservoir storage, Water supply, Water utilization.
Identifiers: Reservoir storage probability.

Some characteristics of the distribution of storage were obtained for use in reservoir operations. The distribution of storage at the end of a unit period of time was derived in terms of the known storage level at the beginning of the period, for simple as well as more complicated release schemes and for any general type of distribution of the inflows into the reservoirs. These include the probabilities of the dam becoming empty or full at the end of the unit period or at the end of each of several unit periods in succession. The distribution of outflow below the dam was obtained, including the case of a nil outflow during the period. The probability of having the desired amount of utilization and the expected amount of water that might be available during the period was also derived. Some of the practical applications of these results in reservoir operations are discussed. (Knapp-USGS)
W70-02111

CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
For primary bibliographic entry see Field 06E.
W70-02128

THE INVESTMENT DECISION FOR SEEPAGE REDUCTION,
Arizona Agricultural Experiment Station, Tucson.
For primary bibliographic entry see Field 06C.
W70-02156

CONTROL OF SEEPAGE IN EARTH DAMS,
Sacramento, Calif.
Harry R. Cedergren.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 106-112, Apr 1969. 6 p, 4 fig, 10 ref.

Descriptors: *Reservoir leakage, *Earth dams, Seepage, Leakage, Drainage, Soil mechanics.

When water is stored behind dams in reservoirs, and energy differential is created, producing pressures and forces in the water that must be controlled to prevent loss of life and damage to property. The seeping water causes two major kinds of problems: (a) those due to piping; and (b) those due to uncontrolled rise and spread of saturation. Protection from seepage usually can be provided by methods that either reduce the quantity of seepage, or control it by drainage. Although each of these two basic methods is sometimes used substantially alone, combinations of these methods usually are employed. The designer should always consider alternate methods that are available in relation to soils and geological conditions at individual sites. The experimental and analytical soil mechanics methods, when applied with experience and judgment, can virtually eliminate serious troubles and aid the designer in obtaining a high level of seepage control at the least overall cost.
W70-02164

FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
For primary bibliographic entry see Field 08E.
W70-02166

SEEPAGE DETECTION BY REMOTE SENSING,
HRB-Singer, Inc., State College, Pa. Radiometrics Lab.
For primary bibliographic entry see Field 07B.
W70-02169

FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
Idaho Univ., Moscow. Engineering Experiment Station; and Argicultural Research Service, Kimberly, Idaho. Snake River Research Center.
For primary bibliographic entry see Field 07B.
W70-02179

TREE SURVIVAL AND GROWTH ON FESCUE COVERED SPOIL BANKS,
Forest Service (USDA), Princeton, W. Va. Northeastern Forest Experiment Station.
William T. Plass.
USDA Forest Serv Res Note NE-90, 1968. 4 p.

Descriptors: *Vegetation effects, *Reforestation, *Strip mines, *Fescues, Vegetation establishment, Kentucky, Spoil banks, Coal mines.

In this study we found a fescue ground cover did not affect survival but did reduce the height growth of sycamore and sweetgum. It had little effect on growth of white pine and loblolly pine. (Curtis-Forest Service)
W70-02211

RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
Forest Service (USDA), Kingston, Pa. Northeastern Forest Experiment Station.
Miroslaw M. Czapowskyj, John P. Mikulecky, and Edward A. Sowa.
USDA Forest Serv Res Note NE-78, 1968. 7 p.

Descriptors: *Vegetation establishment, *Lime, *Anthracite, *Soil stabilization, *Coal mine wastes, Pennsylvania, Vegetation, Coal mines, Mine acids, Fertilization, Mulching.

Crownvetch could not be established on coal breaker refuse in the Anthracite Region of Pennsylvania without the application of lime. Mulching was beneficial but fertilizer had only slight effect. (Curtis-Forest Service)
W70-02212

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
Forest Service (USDA), Princeton, W. Va. Northeastern Forest Experiment Station.
William T. Plass.
USDA Forest Serv Res Notes: NE-52, 1966, 7 p; NE-55, 1967, 8 p; NE-68, 1967, 6 p; NE-69, 1967, 7 p; NE-71, 1967, 7 p; NE-72, 1967, 8 p.

Descriptors: *Strip mines, *Spoil banks, *Roads, Land slides, Coal mines, Kentucky.
Identifiers: Haul roads.

The six research notes covering specific coal reserve districts gives information about the amount, location, and general characteristics of areas disturbed by strip-mining. It is useful for determining economic impact, for planning reclamation programs, and for determining research needs and priorities. Aerial photographs were used to obtain reliable estimates of acreage disturbed by mining and associated coal haul roads in Eastern Kentucky as of October, 1964. Over 55,000 acres were disturbed by strip-mining and an additional 3,900 acres were disturbed by coal haul roads. (Curtis-Forest Service)
W70-02213

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Weldon K. Weigle, and George P. Williams, Jr.
Rural and Urban Roads, p 24-25, June 1968.

Descriptors: *Access routes, *Strip mines, *Road construction, *Soil additives, *Appalachian mountain region, Kentucky, Coal mines, Soil classifications, Compressive strength.

Several bituminous and chemical additives were mixed with silty-loam (A-4 (0-2)) soils collected from three eastern Kentucky counties. The effect of the additives upon the unconfined compression strength of the soils was determined for each additive at 5 and 10 percent treatment levels and one and seven day curing periods. Laboratory test results subjected to multiple comparisons showed SS1h asphalt at the 5 percent level and 7-day cure to be significantly better than all other additives studied at the treatment levels and curing periods studied. As a group the bituminous additives (RT-2, MC-3, SS1h, AE-100, AE-200) performed better at 5 percent levels than at 10 percent. Addition of NaCl and CaCl2 did not affect compressive strength, while study soils with lime at the 10 percent level had nearly twice the compressive strength as at the 5 percent level. (Williams-Forest Service)
W70-02214

FOREST SERVICE RECLAMATION RESEARCH,
Forest Service (USDA), Upper Darby, Pa. Northeastern Forest Experiment Station.
Richard D. Lane.
Mining Congr J, 54 (5): p 38-42, 1968.

Descriptors: *Research facilities, *Project planning, *Strip mines, *Spoil banks, Land reclamation, Appalachia, Hydrology, Engineering, Soil science, Vegetation establishment.

The role of the Forest Service in surface mine reclamation research is discussed along with history of research efforts. The prime objectives of strip-mine research are: (1) to develop practical surface-mining methods that cause minimum damage to forest resources and leave the mined areas in the best possible condition for restoration of these resources; and (2) to find ways to restore forest resources, compatible with adjacent land use, on surface-mined land as rapidly as possible. The research program is concentrated in four major areas--hydrology, engineering, soil science, and revegetation, but the wide variety of problems encountered demands a team approach by scientists trained in several disciplines. Study results are reported as soon as possible so as to be applied in reclamation programs. (Curtis-Forest Service)
W70-02216

INVESTIGATION OF A LINEAR MODEL TO DESCRIBE HYDROLOGIC PHENOMENON OF DRAINAGE BASINS,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 02A.
W70-02238

CURRENT SEEPAGE REDUCTION RESEARCH,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Lloyd E. Myers, and Robert J. Reginato.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 75-78, Apr 1969. 4 p.

Descriptors: *Seepage, Leakage, Linings, Sealants, Reservoir leakage, Spraying.

Four different seepage control methods were described. Waterborne-asphalt emulsions are effective provided certain requirements are met. They are easy to apply and may be particularly useful in leaky reservoirs that cannot be dewatered. Sodium carbonate is a low-cost treatment for reducing seepage from unlined reservoirs in calcium-aggregated soils, which are common in the Southwestern United States. Power-spray equipment was used successfully in cleaning cracked concrete linings and applying crack sealers with a significant reduction in labor costs. Field tests showed that effective linings can be fabricated with fiberglass and asphalt emulsion. These linings are simple to install, relatively low in cost, and are strong and durable. Although additional improvements are possible and will be beneficial, these four methods and materials are useful in their present form. They should be considered by anyone confronted with a seepage problem.
W70-02260

THE EFFECT OF SEEPAGE LOSSES ON STREAM REGIMEN,
Department of the Navy, Washington, D.C.
Donald D. Del Manzo.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 30-34, Apr 1969. 5 p, 2 chart, 7 ref.

Descriptors: *Stage-discharge relations, Hydrograph analysis, Surface-groundwater relationships, Return flow, Inflow, Discharge (Water), Stream gages.

Comparison of relevant data provides substantial proof that the groundwater and surfacewater are one contiguous supply. Surfacewater correlations alone do not yield meaningful estimates of the surface outflow at the downstream gage. Inclusion of the groundwater return flows in the budgetary equation significantly improves the replication of the observed outflows. Use of the Maasland method produces satisfactory results in computing return flows. Further analysis including more of the minor water losses in detail and utilizing statistical techniques of fitting might well increase the accuracy of the model. The relative advantages of using a consumptive use pattern versus a pumping pattern should also be studied.
W70-02273

A NEW METHOD OF INSTALLING PLASTIC MEMBRANES,
Arizona Water Resources Research Center, Tucson.
C. Brent Cluff.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 86-93, Apr 1969. 7 p, 3 photo, 2 dwg, 1 tab, 9 ref.

Descriptors: *Impervious membranes, *Plastics, Linings, Seepage, Reservoir leakage, Leakage.

Plastic liners can be successfully installed and covered in one operation. The use of the plastic-laying chute on small ponds as described in this paper, or larger self-propelled plastic-laying spreaders on reservoirs, should result in a substantial saving in time and money over the more conventional methods of installing and covering plastic. Although the amount of field seaming is increased, the effect of the inherent weakness in field seaming is minimized by the ability to immediately cover the seam. The time required to make a seam in the field is reduced because the plastic is held in place by the soil cover. The chance of damage to the film is greatly lessened since the protective earth cover is applied at the same time the plastic is laid down. This is of particular advantage with the use of plastic having a low puncture resistance, such as polyethylene.
W70-02274

CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
Dow Chemical Co., Midland, Mich. Plastics Dept.; and Dow Chemical Co., Plaquemine, La. Research and Development Div.
D. H. Moeller, and J. R. Ryffel.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 79-85, Apr 1969. 7 p, 7 fig, 3 tab, 1 ref.

Descriptors: *Linings, *Elastomers, *Plastics, Seepage.

Comparisons were made of the structural, chemical, and miscellaneous properties of the four liner materials. It is hoped that this comparative chart and the discussion will provide the data for selection of liner materials on a basis of greater knowledge and understanding.
W70-02275

SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
Portland Cement Association, San Francisco, Calif. Western Region.
For primary bibliographic entry see Field 08F.
W70-02281

FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
Corps of Engineers, Anchorage, Alaska.

Corps Eng Flood Plain Rep, Dec 1968. 39 p, 7 fig, 9 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Alaska, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: Kuskokwim River (Alas), Bethel (Alas), Standard project flood, Intermediate regional flood.

Flooding of the Kuskokwim River, Bethel, Alaska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-02312

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
Texas Univ., Austin. Dept. of Civil Engineering.
Stanley P. Sauer, and Frank D. Masch.
Texas Univ Hydraul Eng Lab Tech Rep HYD 13-6901, May 1969. 104 p, 22 fig, 20 tab, 40 ref.

Descriptors: *Rainfall-runoff relationships, *Water loss, *Reservoirs, *Watershed management, *Mathematical models, Forecasting, Streamflow forecasting, Statistical models, Computer programs, Evaporation, Evapotranspiration, Seepage, Reservoir design, Reservoir leakage, Flood control, Water management (Applied).
Identifiers: Watershed yield.

Methods of determining the effects of upstream flood prevention measures on watershed yield, required for optimum water resources development, are presented. Studies were conducted in 7 study areas in Texas. Reductions in annual yield ranged from 100% in dry years to 4% in a very wet year. Average reductions for an 8-year period ranged from 54% in an area having an average annual runoff of 1.37 inches to 11% in an area having average annual runoff of 6.64 inches. Mathematical models and computer programs for monthly consumption by reservoirs and watershed response to regulation consist of linear multiple regression equations relating monthly consumption to variables representative of the physical processes in evaporation from the free water surface and wetted peripheral soil, transpiration, and seepage away from the pools. These equations have standard errors of estimate ranging from 11 to 16%. Necessary parameters are determined from soil maps and reservoir design. Climatic variables are computed from first order climatological data stations. An annual inflow-outflow relationship may be used as a first approximation of the depletion of annual runoff from the controlled area of a watershed. (Knapp-USGS)
W70-02322

4B. Groundwater Management

WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 03B.
W70-02055

CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 02E.
W70-02060

PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
Geological Survey, Honolulu, Hawaii.
For primary bibliographic entry see Field 03B.
W70-02065

GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
Tennessee Dept. of Conservation, Nashville. Div. of Water Resources; and Geological Survey, Nashville, Tenn.
For primary bibliographic entry see Field 03B.
W70-02071

GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02F.
W70-02091

PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
Geological Survey, Jacksonville, Fla.
For primary bibliographic entry see Field 03D.
W70-02092

EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 05C.
W70-02093

SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
Geological Survey, Baton Rouge, La.
For primary bibliographic entry see Field 02L.
W70-02094

VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 06B.
W70-02110

CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
For primary bibliographic entry see Field 06E.
W70-02128

FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
Idaho Univ., Moscow.
Roy E. Williams, and David W. Allman.
J Hydrol, Vol 8, No 3, p 265-281, July 1969. 17 p, 13 fig, 16 ref.

Descriptors: *Groundwater recharge, *Artificial recharge, *Infiltration, *Loess, *Percolation, Groundwater, Water table, Crops, Infiltrometers, Root systems, Hydrogeology, Piezometers, Aquifers, Idaho, Dyes, Tracers, Hydrographs, Soil erosion, Bibliographies.
Identifiers: Holes, Groundwater system.

Hydrographs of shallow piezometers installed in a basin overlain primarily by loess reveal that water infiltrating and percolating through the loess recharges groundwater. Local gravity groundwater flow systems adjacent to some intermittent streams thereby are established. Relief on the water table is at a maximum during late winter or spring, but decreases steadily through the summer when dry weather and maximal evapotranspiration minimize recharge. Cultivation practices and type of crop grown are 2 important factors that make the loess susceptible to infiltration and percolation. Smooth, heavily worked surfaces (commonly planted in winter wheat) act as a major limitation to infiltration capacity; soil moisture concomitantly is low beneath such surfaces. Root mats developed beneath grassy surfaces provide optimal conditions for infiltration and, consequently, for recharge. Measured infiltration capacities are often influenced by near-vertical tubular openings extending at least 30 ft deep in the loess. Tracer studies indicate that when sufficient water is available and when surficial infiltration capacity is sufficiently high to form a zone of positive pressure above these openings, water is conducted ahead of the saturation front. (USBR)
W70-02154

FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
Clemson Univ., S.C. Water Resources Research Inst.
For primary bibliographic entry see Field 07B.
W70-02241

RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUND-WATER-LEVEL CONDITIONS,
W. C. Walton.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 17-22, Apr 1969. 6 p, 1 fig, 4 map, 1 tab, 3 ref.

Descriptors: *Induced infiltration, *Groundwater recharge, Aquifers, Water table, Surface-groundwater relationships, Analog models, Simulated analysis, Streambeds.

Little, if any, attention has been given to the complex nature of recharge from induced streambed infiltration under varying groundwater-level conditions. Streambeds are often simulated in mathematical models by hypothetical recharge boundaries located with aquifer-test data. Under heavy pumping, the recharge boundaries may not correctly simulate leakage through streambeds and computed drawdowns may be greatly in error. Streambeds have been simulated in analog models by a ground wire which is equivalent to simulating a streambed as a hypothetical recharge boundary. In some analog models, the streambed is simulated with vertical arrays of resistors. Simulation of induced infiltration by a hypothetical recharge boundary, such as a ground wire or simple vertical arrays of resistors has been shown to be incorrect for certain conditions, and will lead to misleading estimates of the potential yields of aquifer unless the pumping conditions are such that the water table is not lowered below the streambed and maximum induced infiltration rates do not occur. In evaluating groundwater resources, streambeds must be simulated in mathematical and analog models in such a way that the following conditions are considered: (1) Leakage of water through a streambed is directly proportional to the drawdown beneath the streambed until the water table declines below the streambed. Thereafter, induced infiltration remains constant providing the stream stage and temperature remains stationary. (2) Provided that the water table remains below the streambed, leakage of water through a streambed is directly proportional to the average depth of water in the stream and varies with stream-stage changes and changes in the temperature of the surface water.
W70-02263

DEVELOPMENT OF SYSTEMS FOR GROUND-WATER RECHARGE INTO THE OGALLALA FORMATION,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
Marvin J. Dvoracek, and Rolland Z. Wheaton.
Available from the Clearinghouse as PB-188 504, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, Texas Tech Water Resources Center Report WRC 69-5, May 1969. 22 p, 3 tab, 3 fig, 21 ref. OWRR Project B-016-TEX.

Descriptors: *Groundwater recharge, *Well recharge, *Pit recharge, *Playa lakes, Sedimentation, Ogallala formation, Filter systems.

Constructed pits were evaluated as mechanisms for artificial groundwater recharge into the Ogallala Formation of the High Plains of Texas. The pits were located on the outer periphery of a playa lake (wet weather lake) and possessed the surface dimensions of 250 feet x 100 feet and 10 feet deep. Recharge rates of up to 1.5 feet per day of pit water level decline were noted, but continued recharge of the high sediment content waters reduced rates in some instances to 0.1 foot per day. The pits proved to be efficient recharge mechanisms when the sediment problem was nonexistant. Drying and freezing or overwintering of this sediment permitted partial recovery of recharge rates without additional maintenance. Buried tile drains used as filter systems for water to be used in recharge were studied. Filter media of sands, gravels, sand-gravel combinations, and organic material were used with sands and gravels proving most effective. Waters resulting from this system were recharged through a multipurpose well without detrimental effects. Some clarification of water is required for economical and efficient artificial recharge of surface runoff waters through multiple purpose wells and constructed pits.
W70-02282

4C. Effects on Water of Man's Non-Water Activities

FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Willie R. Curtis.
J Soil and Water Conserv, 21 (3): p 101-102, 1966.

Descriptors: *Storm runoff, *Diversion, *Flow measurement, *Water conservation, Runoff, Overland flow, Erosion control, Flood control, Watershed management, Wisconsin.

Surface runoff from ridge-top farmland in the Driftless Area is at least partially dissipated within the forest zone below. Much runoff leaving upland fields did not reach the valleys below as surface flow.
W70-02203

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-02204

GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Willis G. Vogel, and William A. Berg.
J Soil and Water Conserv, 23 (3): p 89-91, 1968.

Descriptors: *Strip mines, *Cover crops, *Grasses, *Legumes, *Vegetation establishment, Spoil banks, Reclamation, Revegetation, Kentucky, Hydrogen-ion concentration, Nutrient requirements, Plant growth, Soil chemical properties.
Identifiers: *Acidic spoils, *Quick cover, Strip-mine reclamation.

A vegetation cover is needed on most strip-mine spoils immediately after mining to reduce runoff and erosion. Field experiments showed that fertilized weeping lovegrass provided cover on acid spoils faster than any other perennial grass or legume tested. Greenhouse studies showed that weeping lovegrass also was more tolerant of extremely acid spoils (pH 4.0 - 4.5), than any of the other species tested. Switchgrass was only slightly less tolerant of acid spoils than weeping lovegrass but more tolerant than K-31 tall fescue. However, satisfactory cover is established too slowly by switchgrass. Even the more acid tolerant legumes grew poorly and did not nodulate in most of the acid spoils with pH below 4.5.
W70-02206

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
Forest Service (USDA), Oxford, Miss. Southern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-02207

HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Grant Davis.
In: International Union of Forest Res Organizations Proc, 13th Congress, Munich, p 420-443, Sept 1967.

Descriptors: *Watershed management, *Surface drainage, *Strip mines, *Spoil banks, Hydrology, Coal mines, Surface runoff, Water pollution sources, Appalachia, Water resources, Streamflow.

Contour strip-mining may have profound effects on stormflow, sediment load, and water quality of streams in a watershed. The degree of impact depends upon the proportion of area mined, hydrologic characteristics of the spoil material, topography of the watershed, and other factors. For the most part, standard techniques are used to measure the hydrology of strip-mined watersheds; but modifications are sometimes necessary. Because mining is extensive and subject to little experimental control, the multi-watershed approach

offers many advantages as a method for determining the hydrologic effects of such mining. (Curtis-Forest Service)
W70-02217

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-02286

ROADSIDE EROSION SURVEY,
Soil Conservation Service, Madison, Wis.
For primary bibliographic entry see Field 02J.
W70-02327

4D. Watershed Protection

VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-02045

THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
Institut d'Armenagement et d'Economie de l'Eau, Warsaw (Poland).
For primary bibliographic entry see Field 08B.
W70-02106

CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
For primary bibliographic entry see Field 06E.
W70-02128

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Willie R. Curtis.
J Soil and Water Conserv, 22 (1): p 25-26, 1967.

Descriptors: *Overland flow, *Storm runoff, *Outlets, *Diversion, *Water spreading, Runoff, Infiltration, Terracing, Flood control, Watershed management, Wisconsin.

Overland runoff from ridgetop farmland has been adequately controlled by diverting flow from natural drainageways to forested slopes when the diversion outlets have been treated. Outlet treatments consisted of natural forest, logs, and contour trenches.
W70-02204

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
Forest Service (USDA), Oxford, Miss. Southern Forest Experiment Station.
S. J. Ursic.
USDA Forest Serv Res Pap SO-46, 1969. 20 p.

Descriptors: *Burning, *Storm runoff, *Accelerated erosion, *Overland flow, *Peak discharge, Sediment yield, Rainfall-runoff relationships, Small watersheds, Watershed management, Grasses, Soil erosion, Mississippi.
Identifiers: *Experimental watersheds, *Prescribed burning, *Post-fire erosion.

Reports 3-year results of a prescribed burn on two small watersheds supporting a cover of native grass. Comparisons were against an unburned control watershed. Variables included stormflows, overland flows, peak discharges, and sediment yields.
W70-02207

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
William A. Berg, and Robert F. May.
Mining Congr J, 55 (3): p 31-34, 1969.

Descriptors: *Strip mines, *Overburden, *Stratigraphy, *Soil chemical properties, Kentucky, Hydrogen-ion concentration, Phosphates, Reclamation, Strip mine wastes, Coal mines, Mining, Engineering, Shales, Sandstones, Spoil banks, Nutrient requirements, Mine acids.
Identifiers: *Acidic spoils, *Plant-available phosphorus, *Strip-mine reclamation, Overburden movement and placement, Acid strata, Rider coal, Bone coal.

Samples of visibly different strata were collected from highwall sections at six strip-mines in eastern Kentucky. Hydrogen-ion concentrations (pH) and plant-available phosphorus (Bray no. 1) were determined on the samples. Most of the extremely acid strata (pH below 4.0) were rider coal seams, bone coal, or thin shale strata just above or below the rider coal or bone coal. These materials can be recognized visually in the field suggesting the use of mining techniques for separating this extremely acid material and burying it under less acid overburden. Extremely acid shales and sandstones occurred less frequently but are not visually distinguishable from non-acid shales and sandstones. A few strata at each highwall section tested moderate in plant-available phosphorus, but the majority of the strata tested low to very low. The position of the strata with moderate phosphorus levels was inconsistent among highwall sections even on the same strip mine. Thus mining to place spoils containing phosphorus in an exposed position for vegetation appears impractical. (Vogel-Forest Service)
W70-02208

SPOIL BANK STABILITY IN EASTERN KENTUCKY,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 08D.
W70-02210

EROSION FROM ABANDONED COAL-HAUL ROADS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Weldon K. Weigle.
J Soil and Water Conserv, 21 (3): 1966. 1 p.

Descriptors: *Appalachian mountain region, *Strip mines, *Access routes, *Washouts, *Gully erosion, Watershed management, Kentucky, Coal mines.

A 1964 survey showed approximately ten percent of the area disturbed by strip mining in eastern Kentucky was due to the construction of coal haul roads. If not maintained for further use, or if abandoned without adequate reclamation, these roads are detrimental to the water quality of streams flowing from mined watersheds. Eight coal haul roads located in Bell, Harlan, and Perry Counties of eastern Kentucky were studied after periods of abandonment ranging from eight months to two years. The mean erosion from roads in sandy silt was 2.6 inches, and from roads in clayey silt was five inches per year across the entire width of the road prism. The mean prism width was found to be 65 feet. (Williams-Forest Service)
W70-02215

CONSERVATION IN A NEW TOWN,
Soil Conservation Service, Hyattsville, Md.
For primary bibliographic entry see Field 02J.
W70-02329

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
Indian Inst. of Tech., Kharagpur. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 02J.
W70-02331

INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
Soil Conservation Service, Spartanburg, S.C.
For primary bibliographic entry see Field 06B.
W70-02377

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
Geological Survey, Idaho Falls, Idaho.
J. B. Robertson.
Available from the Clearinghouse as IDO-22051, TID-4500, $3.00 for paper copy; $0.65 in microfiche. Geol Surv Open-file Rep, Ref No IDO-22051, July 1969. 37 p, 14 fig, 2 tab, 10 ref.

Descriptors: *Injection wells, *Tracers, *Radioisotopes, *Disposal, *Radioactive wastes, Gases, Tracking techniques, Monitoring, Permeability, Aquifers, Aquicludes, Diffusion, Seepage, Pressure, Mathematical models, On-site tests, On-site investigations.
Identifiers: Gas injection.

Xe-133 gas was injected rapidly under pressures of 1.5 to 1.65 psig with one million cubic feet of air into permeable basalt strata at the National Reactor Testing Station, Idaho. The subsurface Xe-133 was monitored by Geiger-Muller detectors and by air samples from observation wells surrounding the injection well. Underground distribution patterns after injection pressures had dissipated were evaluated by materials-balance analyses. Molecular diffusion rates of Xe-133 from the ground were estimated using a simplified numerical model. A maximum flux rate of 2,560 micro/Ci/hr from a ground-atmosphere interface of 2.88 million sq ft was calculated for the first day after injection. Total diffusion loss was estimated to be 0.37 Ci for the total area during the 26-day observation period. The calculated rates had fairly good agreement with the flux rates at the ground surface. Molecular diffusion and barometric effects could produce the flux rates measured; however, the rates were too low to remove a significant portion of the 987 Ci of Xe-133, nearly all of which remained underground and decayed. The general methods and techniques used for the diffusion, materials balance, and barometric analyses were generally satisfactory and be applied to future underground gas-injection problems. (Knapp-USGS)
W70-02072

STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
Gulf Coast Marine Health Sciences Lab.
For primary bibliographic entry see Field 05B.
W70-02100

ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
Pittsburgh Univ., Pa. Graduate School of Public Health.
Julian B. Andelman.
J Water Pollut Contr Federation, Vol 40, No 11, Part 1, p 1844-1860, Nov 1968. 17 p, 4 fig, 2 tab, 35 ref.

Descriptors: *Electrodes, *Ions, *Water analysis, Analytical techniques, Alkali metals, Chemical

potential, Phosphates, Nitrates, Sulfates, Halides, Copper, Magnesium, Calcium, Instrumentation, Hardness (Water), Water chemistry.
Identifiers: *Ion-selective electrodes, Activity, Activity coefficient, Concentration.

Recently, several electrodes for such ions as flouride, nitrate, sulfide, sodium, potassium, calcium, and total hardness (divalent ions) have become commercially available. The potentials measured by these electrodes, which sense activity rather than concentration, are influenced to varying extents by the presence of ions other than those whose measurements are desired. The relationships of these effects to be measured potentials are discussed, as are techniques for interpretation in terms of ion concentrations, rather than activities. Among the advantages of these electrodes for water analysis are their speed and their potential for in situ monitoring of ions in natural and treated waters. Some applications of these electrodes for water analysis are discussed, including comparisons between their analyses and those obtained by other techniques. (Carstea-USGS)
W70-02112

PESTICIDES,
Little (Arthur D.), Inc., Cambridge, Mass.
For primary bibliographic entry see Field 05G.
W70-02132

EFFECT OF pH ON THE RATE OF BOD OF WASTEWATER,
Maryland Univ., College Park. Dept. of Chemistry; Birla Inst. of Tech. and Science, Pilani (India). Dept. of Civil Engineering; and Roorkee Univ. (India). Dept. of Chemistry.
S. K. Mukherjee, A. K. Chatterji, and I. P. Saraswat.
J Water Pollut Contr Federation, Vol 40, No 11, Part 1, p 1934-1939, Nov 1968. 6 p, 5 fig, 2 tab, 13 ref.

Descriptors: *Biochemical oxygen demand, *Acidity, *Waste water (Pollution), Domestic wastes, Temperature, Alkalinity, Water quality, Analytical techniques, Rates, Water properties.
Identifiers: Biochemical oxygen demand rate.

The influence of pH on the rate constant, k, and the ultimate demand, L, was studied in the 6 to 8 range and at temperatures from 20 deg to 37 deg C. Values of k at all test temperatures were maximum in the acidic range, minimum in the neutral zone, and tend to decrease as pH goes up. Values of L tend to decrease with an increase in pH, increase in the neutral zone, and decrease in the alkaline pH range. (Carstea-USGS)
W70-02308

STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
Dominic M. Di Toro.
ASCE Proc, J Sanit Eng Div, Vol 95, Pap 6723, No SA4, p 699-703, Aug 1969. 5 p, 13 ref.

Descriptors: *Path of pollutants, *Water quality, *Streamflow, *Mathematical models, Digital computers, Computer programs, Biochemical oxygen demand, Dissolved oxygen.
Identifiers: *Method of characteristics.

The method of characteristics is applied to the form of the one dimensional continuity equation that is commonly employed in the analysis of the distribution of dissolved substances, such as BOD and dissolved oxygen, in natural rivers and streams. The resulting pair of ordinary differential equations can be solved numerically using widely available computer programs. This method appears to be superior to methods based on approximations using a rectangular grid in terms of the accuracy obtained and the computer time and memory required. (Knapp-USGS)
W70-02326

DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
New Brunswick Univ., Federicton. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W70-02341

SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
Wisconsin Univ., Madison. Dept. of Wildlife Ecology; and California Univ., Berkeley. Dept. of Nutritional Sciences.
For primary bibliographic entry see Field 05C.
W70-02342

A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
Mississippi State Univ., State College. Dept. of Zoology.
W. David Burke, and Denzel E. Ferguson.
Trans of Am Fish Soc, Vol 97, No 4, p 498-501, 1968. 1 tab, 1 fig, 3 ref. ES00086-03 from Office of Resources Devel and UI 00348-01 from Nat Center for Urban and Industrial Health, U S Pub Hlt Service.

Descriptors: *Installation, *Laboratory equipment, Automatic control, Research equipment, Flow control, Flow rates, Design, Application equipment.
Identifiers: *Toxicant diluting systems, Static systems, Flow-through systems.

The objectionable features of using static tests to determine the toxicity of pesticides to aquatic organisms are described. An accurate and inexpensive flow-through system in which test solutions are constantly renewed, is described. It consists of a toxicant source (acetone+ toxicant) and a water source. These are mixed in a baffled chamber. Flow rate is determined by tube diameter, height of water column above the outlet tube, and total length of outlet tube. From the baffled mixing chamber the diluted stock solution is passed into the test tanks at different flow rates and at different concentrations. The performance of this system was evaluated and was found to be exceedingly accurate. (Sjolseth-Washington)
W70-02352

IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
New Brunswick Univ., Fredericton. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W70-02354

PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
Maine Univ., Orono.
For primary bibliographic entry see Field 05C.
W70-02357

BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05B.
W70-02442

5B. Sources of Pollution

WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
Geological Survey, Washington, D.C.
Edward F. McCarren, and Walter B. Keighton.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $0.35. Geol Surv Water-Supply Pap 1879-H, p H1-H48, 1969. 48 p, 11 fig, 6 tab, 12 ref.

Descriptors: *Streamflow, *Water quality, *Data collections, *Pennsylvania, Acid mine water, Hydrologic data, Solutes, Dissolved oxygen, Water pollution sources, Hydrographs, Water temperature, Discharge (Water).
Identifiers: Lehigh River Basin (Penn).

The Lehigh River, 100 miles long, is the second largest tributary to the Delaware River. It drains 1,364 sq mi in 4 physiographic provinces. The Lehigh River basin includes mountainous and forested areas, broad agricultural valleys and areas of urban and industrial development. In the headwaters the water is of good quality and has a low concentration of solutes. Downstream, some tributaries receive coal-mine drainage and become acidic; others drain areas underlain by limestone and acquire alkaline characteristics. The alkaline streams neutralize and dilute the acid mine water where they mix. The dissolved-oxygen content of river water, which is high in the upper reaches of the stream, is reduced in the lower reaches because of lower turbulence, higher temperature, and the respiration of organisms. Most of the river water requires only moderate treatment for industrial use and public distribution throughout the Lehigh River valley. At times, however, some segments of the main river and its tributaries transport industrial wastes and acid coal-mine drainage. Since May 1966 an instrument installed by the U.S. Geological Survey at Easton, Pa., has continuously recorded such water-quality parameters as specific conductance, temperature, and dissolved oxygen content. Streamflow and water quality data are tabulated. (Knapp-USGS)
W70-02052

WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
Geological Survey, Washington, D.C.
E. C. Mallory, J. O. Johnson, Jr., and R. C. Scott.
Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $0.65. Geol Surv Water-Supply Pap 1535-O, p 01-031, 1969. 31 p, 1 fig, 1 plate, 8 tab, 14 ref.

Descriptors: *Radioisotopes, *Water quality, *Water chemistry, *Data collections, Water analysis, Chemical analysis, Streamflow, Solutes, Radiochemical analysis, Uranium radioisotopes.
Identifiers: Radium, Radiogeochemical prospecting.

Water samples were collected from 36 rivers during low, medium and high flows. The drainage areas above the sampling sites represent about 55% of continental United States (including 86,000 sq mi of Alaska) and 155,000 sq mi of Canada. During the 1960-61 water year the total uranium-solute load ranged from about 100 pounds contributed by the Nezinscot River to 695,000 pounds contributed by the Mississippi River. The calculated total uranium-solute load of the rivers sampled was used to estimate that about 2 million pounds of uranium was carried in solution from the continental United States to the oceans during this water year. The calculated radium-solute load for the sampling period ranged from about 0.000025 pounds for the Nezinscot River to 0.25 pounds for the Mississippi River. The gross solute load of radium from the conterminous United States to the oceans for water year 1960-61 was estimated to be about 0.67 pounds. (Knapp-USGS)
W70-02054

STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
Gulf Coast Marine Health Sciences Lab.
V. L. Casper, R. J. Hammerstrom, E. A. Robertson, Jr., J. C. Brigg, Jr., and J. L. Gaines.
Dep Health, Educ and Welfare, Public Health Serv Rep, 1969. 47 p, 3 fig, 10 tab, 20 ref, 3 append.

Descriptors: *Pesticides, *Oysters, *Bays, *Estuaries, *Public health, Water pollution effects, Water pollution sources, Chlorinated hydrocarbon pesticides, DDT, Dieldrin, Endrin, Heptachlor.

Identifiers: DDE, DDD, Methoxychlor, Toxaphene, Mobile Bay (Ala).

A study to gain information on the amount of chlorinated pesticides in oysters and estuarine waters of the Mobile Bay area was made with particular reference to public health. Oyster, water, and bottom sediment samples were taken from Mobile Bay. Water and bottom sediment samples were collected from the Tensaw River immediately north of Mobile Bay. DDT and its metabolites DDD and DDE were found more frequently and at higher levels than were the other chlorinated pesticides. DDT was found in 99% of the oyster samples in the range of less than 0.01 to 0.58 ppm. DDD and DDE were detected in all 82 oyster samples in the ranges of 0.01 to 0.72 ppm and 0.01 and 2.31 ppm, respectively. DDT, DDD, and DDE were detected in 79, 80, and 84%, respectively, of the 131 water samples. The highest values for DDT, DDD, and DDE in the water samples were 0.008 ppm, 0.001 ppm, and 0.002 ppm, respectively. (Knapp-USGS)
W70-02100

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT: 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02L.
W70-02119

RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION: A REVIEW,
North Carolina State Univ., Raleigh.
J. W. D. Robbins, and G. J. Kriz.
Trans Amer Soc Agr Eng, Vol 12, No 3, p 397-403, May-June 1969. 7 p, 2 tab, 97 ref.

Descriptors: *Agricultural engineering, *Groundwater, *Pollutants, *Farm wastes, Agriculture, Pollution abatement, Farm management, Waste water (Pollution), Pesticides, Insecticides, Herbicides, Bibliographies, Saline water, Irrigation water, Waste water disposal, Waste disposal, Water pollution, Water pollution control, Water Pollution sources.
Identifiers: Groundwater quality, Pollution control.

Groundwater is a water resource and a potential medium for receiving wastes. Agricultural enterprises produce wastes that can lead to rapid degradation of groundwater. Agricultural engineers are responsible for evaluating agricultural groundwater pollution problems and recommending control and abatement measures. The purpose of this paper is to orient agricultural engineers on groundwater pollution problems caused by agricultural practices in 3 general areas: (1) evaluation of groundwater as a receiving medium for agricultural wastes; (2) characterization of the source of the pollutants; and (3) delineation of the types of solutions needed for agricultural groundwater quality problems. Agricultural groundwater pollutants reviewed are animal wastes, fertilizers, pesticides, plant residues, and saline waste water. (USBR)
W70-02161

VIRUS MOVEMENT IN GROUNDWATER SYSTEMS,
Arkansas Univ., Fayetteville. Water Resources Research Center.
William A. Drewry.
Available from the Clearinghouse as PB-188 285, $3.00 in paper copy, $0.65 in microfiche. Research Project Technical Completion Report, Arkansas Water Resources Research Center, Publication No 4, Feb 1969. 76 p, 41 tab, 13 fig, 11 ref. OWRR Project A-005-ARK.

Descriptors: *Viruses, Bacteriophage, *Water pollution, Septic tanks, *Soil disposal fields, Soil contamination.

The extent is investigated to which soil acts as an agent in the transmission of waterborne viruses. Since many waterborne outbreaks of viral diseases have involved small wellwater supplies contaminated by effluents from subsurface wastewater disposal systems, there is a great need for such information. Results show that virus adsorption by soils is greatly affected by the pH, ionic strength, and soil-water ratio of the soil-water system and various soil properties. It is shown that one cannot predict the relative virus adsorbing ability of a particular soil based on the various tests normally used to characterize a soil. Virus movement through a continuous stratum of common soil under gravity flow conditions and with intermittent dosing should present no health hazard if usual public health practices relating to locating water supply wells are followed. Test results indicate no greater or lesser movement of virus through soils with a highly polluted water than with a non-polluted water.
W70-02240

LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
Yale Univ., New Haven, Conn. Osborn Zoological Lab.
For primary bibliographic entry see Field 02H.
W70-02250

PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
Vermont Univ., Burlington. Dept. of Agricultural Economics; and Vermont Univ., Dept. of Animal and Dairy Science.
For primary bibliographic entry see Field 05E.
W70-02299

INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
Idaho Operations Office (AEC), Idaho Falls. Health Services Lab.

Bruce L. Schmalz, Compiler. Atomic Energy Res and Develop Rep IDO-12069, Idaho Oper Office, June 1969. 166 p, 79 fig, 27 tab, 21 ref, 3 ref, 3 append.

Descriptors: *Waste disposal, *Radioactive waste disposal, *Gases, *Injection wells, *Idaho, Nuclear wastes, Radioactive wastes, Air pollution, Permeability, Diffusion, Mixing, Tracers, Monitoring, Tracking techniques.
Identifiers: Gas injection.

To study the feasibility of disposing of radioactive gas wastes in injection wells at the National Reactor Test Station, a test was conducted by injecting 1 million cu ft of air, containing 1,000 Ci xenon-133, into a porous zone 120 feet below the land surface. The movement of this gas was studied by means of air samples and radiation detection equipment placed in surrounding monitoring wells. Air samples also were collected at the land surface and from strategic locations in the atmosphere. Analysis of the results using diffusion equations verified that the movement could be explained on this basis. Variation of estimated flux from that measured was explained on the basis of barometric influences. It was estimated that 0.5 of 1,000 Ci injected escaped to the atmosphere during a 24-day period. This amount resulted in concentrations that were less than the mean concentration of xenon-133 in the injected air by a factor of 100,000,000. Mathematical models describing the flow by convective forces created by injection also were tested and found adequate for making engineering estimates. (Knapp-USGS)
W70-02321

A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
Battelle-Northwest, Richland, Wash.
R. T. Jaske, and J. L. Spurgeon.
Water Research, Vol 2, 1968, p 777-802. 10 ref. AEC Contract No AT (45-1) 1830.

Descriptors: *Heat transfer, *Mathematical models, *Computer models, Turbulence, *Thermal pollution, Energy budget, Temperature, Heat balance, Thermodynamic behavior, Streams.

The description and designs of mathematical models for the prediction of conservative and nonconservative materials in streams is presented. The major emphasis is on the prediction of temperature changes in streams due to energy plants using atomic energy. The hydraulic part of the model is based on similarity of turbulent flow which leads to the conclusion that there is a fixed relationship between the volume and the surface area of a section of a universal channel. The energy budget method was used for the evaluation of the mass or heat balance in a section of the model. The model considers the weather data as one of the major inputs. The input data are grouped into three parts: (1) weather parameters; (2) reservoir or river dimensional data; and (3) advected heat or material cards up to 9300 individual cards. The particular procedure was developed for density currents which occur with densimetric Froude numbers less than 0.26. The model permits the advection of heat into any of the input defined troughs. Two streams carrying heated discharges were used for testing of the model. (Novotny-Vanderbilt)
W70-02398

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
Texas Electric Service Co., Fort Worth.
H. R. Drew, and J. E. Tilton.
Water Pollution Control Federation 42nd Annual Conference, Oct 5-10, 1969, Dallas, Texas. Mss 19 p, 3 fig, 17 ref.

Descriptors: *Temperature, *Reservoirs, *Fish, *Thermal pollution, Nutrient requirements, Electric power, Water conservation.
Identifiers: Cooling ponds, Beneficial effects.

Streams in Texas vary in temperature from 33 deg F to 110 deg F. Fish and other aquatic organisms have adapted to these varied natural conditions. Fish have been taken from natural waters of 102 deg F by state biologists. The conditions in the man-made reservoirs are different. The game species in these reservoirs show exceptional growth in the first two years and then start declining rapidly. The reason for this decline with age are the absence of native game species adapted to the reservoir environment and a loss of fertility. Inorganics leached from the soil are utilized in the productivity chain. With age these minerals are lost through absorption by living organisms which subsequently die and settle to the bottom. Because of stratification the nutrients do not re-enter the circulatory systems. The problem of utilizing nutrient material available in the bottom layers has been overcome to some extent in small ponds by using aerators or mixers. Extensive feeding programs at fish hatcheries in Texas have shown maximum growth of channel catfish and largemouth bass at water temperature of 75 deg F. The continuous recirculation of water within the reservoirs by the powerplant results in a mixing effect. It will also result in increased aeration. Due to these factors the powerplant reservoirs have remained highly productive since impoundment and have maintained a well balanced fish population. (Upadhyaya-Vanderbilt)
W70-02400

SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
Institute of Hydrotechnical Research, Bucharest (Rumania).
V. Ghederim, and I. Ghita.
Tribune Centre Belge Etude et de Documentation des Eaux, No 292, p 134-138, Mar 1968. 9 ref.

Descriptors: *Thermal powerplants, *Pollutant identification, *Water quality, Path of pollutants, Water pollution, Water pollution sources, Sedimentation, Alkalinity, Suspension, Turbidity, Sediment transport, Settling basins.

Research was performed in 2 power stations, one of 120 MW capacity (A) and the other of 200 MW capacity (B) in order to establish the design of a new station of 700 MW capacity (C), and the disposal of its waste water. A used low-quality coal (90%) and natural gas (10%) as fuel. The waste water had a high alkalinity, and large quantities of minerals settled easily without coagulants. The waste water flow was 300-400 l/s. After settling, the pH decreased as well as the sulfide and alkalinity. B used a coal with lower ash content and higher caloric value (50%) and natural gas (50%). The raw waste water had an alkalinity greater than A, suspended matter similar to A, and less sulfide. The flow was 200-300 l/s. After simple settling as in A, the pH, alkalinity, and sulfide decreased. The ashes coming from the dust of the combustion gas and the soot from the coal were mixed with carrying waters (10/1) (for the coal to be used in the new station). The pH, alkalinity, and the sulfide content were similar to those of the other stations. The total salt content, hardness, and Ca content were higher. Harm may be done by waters coming from such plants which use solid fuel. The danger comes from the high content of mineral suspended matter, relatively high alkalinity, and high sulfide. Settling in special ponds is recommended. After settling, the pH decreases as well as the sulfide content, but it is not sufficient to satisfy the limits allowed for disposal in surface water. To obtain a maximum pH of 8.5 in the waters coming from the settling ponds, the dilution recommended is 12/1 - 20/1, and for sulfide less than 100/1. (Novotny-Vanderbilt)
W70-02403

MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
Eidgenoessische Technische Hochschule, Zurich (Switzerland).
O. Jaag.
Verh Internat Verein, Limnol, Vol 14, p 41-58, July 1961.

Descriptors: *Self-purification, *Sedimentation, *Rivers, *Streams, Adsorption, Decomposing organic matter, Carbohydrates, Proteins, Alcohols, Phenols, Aerobic conditions, Bacteria, Aquatic microbiology, Water pollution effects, Aerobic bacteria, Biochemical oxygen demand, Dissolved oxygen, Turbidity, Water quality, Eutrophication, Nitrates, Phosphates.

The description and discussion of processes which are generally called self-purification is presented. The classical definition of pollution is stated and then the decomposition chains of different compounds are described, e.g., the decomposition processes of carbohydrates, organic acids, alcohols and ketones, cellulose, lignin, proteins, etc. The role of microorganisms is discussed and compared with purification processes in the waste water treatment plant. On the basis of new research results it is stated that some algae have a positive influence on the biochemical decomposition rate. Radioactive pollution is separated and looked upon as a particular problem. The self-purification of a radioactive pollutant is primarily the result of physical processes and biological adsorption of radionuclides. Hydraulic conditions (velocity, depth) are very important in determining the saprobic system. A value of minimal oxygen content of 3-4 mg O2/l is recommended. (Novotny-Vanderbilt)
W70-02405

BIBLIOGRAPHY ON THERMAL POLLUTION.
American Society of Civil Engineers, New York. Committee on Thermal Pollution.

Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 93, No SA3, p 85-113, 1967.

Descriptors: *Bibliographies, *Thermal pollution, *Instrumentation, *Water supply, Aquatic life.

The initial charge of the ASCE Committee on Thermal Pollution of the Sanitary Engineering Division was to investigate and correlate available information regarding the effect, from a sanitary engineering standpoint, of the unnatural increase or decrease of water temperature caused by the industrial use of water. The general categories of the resulting bibliography include (1) general properties of heat and heat exchange between water and atmosphere; (2) effects of heated discharges on the receiving body of water; and (3) effects of heated discharges on uses made of the receiving body of water. Categories (2) and (3) contain the greater number of articles; specifically studies on cooling ponds, water supplies, lakes and reservoirs, rivers and streams, stratified flow problems, mixing and dispersion, instrumentation methods and devices, and effects on aquatic life. The bibliography is in alphabetic order according to author. It is not in any order based on the classifications given above. A total of 879 references are given but no comment is made as to the relevance of any article or how much of the article is related to thermal pollution. Articles are not reviewed or commented upon. (Rietveld-Vanderbilt)
W70-02410

DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
Geological Survey, Washington, D.C.
H. Messinger.
Geological Survey Professional Paper 475-C, p C175-C178, 1963. 3 fig, 3 ref.

Descriptors: *Heat transfer, *Cooling, *Energy budget, Temperature, Streams, Solar radiation, Evaporation, Convection, Thermal powerplants.

An energy-budget analysis of a heated stream failed to account for the observed rapid cooling. Discrepancies between predicted and actual downstream temperatures were attributed primarily to inadequacies in existing methods for measuring the effective solar and atmospheric irradiation of partially shaded water surfaces. The greatest deviation from theory occurred during the daylight hours. These observations give greater weight to the possibility of errors in the net incoming atmospheric and solar radiation terms. Windspeed inaccuracies were not deemed to be important in this case. (Novotny-Vanderbilt)
W70-02414

BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
Colorado State Univ., Fort Collins.
J. W. Boyd, T. Yoshida, L. E. Vereen, R. L. Cada, and S. M. Morrison.
Available from the Clearinghouse as PB-188 515, $3.00 in paper copy, $0.65 in microfiche. Sanitary Engineering Paper No 5, June 1969. 22 p, 12 tab, 11 fig, 21 ref. OWRR Project A-001-COLO.

Descriptors: *Soil microbiology, *Bacterial mobility, *Bacterial survival, *Zeta, potential, Microbiology, Groundwater, Water quality.

Studies to elucidate some of the basic mechanisms by which surface pollution may gain entrance to subsurface water supplies were conducted. Measurements of survival of selected bacteria in certain soil types found in Larimer County, in an area northeast of Fort Collins, Colorado, were made. Samples of two soil types were analyzed chemically and the effects of soil moisture, organic matter, chelation agents and soil sterility upon bacterial life were observed. The role of bacterial predators found in soil was determined, as were the roles of selected inorganic and organic compounds and soil extracts upon bacterial nutrition and/or survival. The collected data showed that while moisture and nutritive value of soils were important for bacterial survival, microbial overpopulation was a major cause of bacterial death. Microbial predators existing in these soils had little or no effect on bacterial survival. Further research was initiated to determine the effects of particulate matter and bacterial surface charge on the mobility of bacteria. Data showed that the size of sand granules and the specific type of ion present in bacterial suspensions greatly affected the mobility of bacteria through sand columns. Bacterial surface charges (zeta potential) were determined in water and in the presence of certain ions. Specific ions markedly changed the zeta potential of the bacteria tested. An attempt was made to correlate the zeta potential data with the mobility values obtained with sand columns. The value of a 'Pollution Index' rating for soils was discussed.
W70-02442

5C. Effects of Pollution

EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
Robert B. Leonard.
Kans State Dep Health Environ Health Serv Bull No 1-10, 1969. 17 p, 6 fig, 6 tab, 5 ref.

Descriptors: *Return flow, *Irrigation water, *Water quality, *Water pollution sources, *Kansas, Base flow, Streamflow, Groundwater movement, Surveys, Data collections, Hydrologic data, Discharge (Water), Hydrologic budget.
Identifiers: Cedar Bluff Irrigation District (Kans).

Groundwater discharge from the expanding Cedar Bluff Irrigation District, Kansas, constituted successively larger proportions of low streamflow measured in the Smoky Hill River during 7 salinity surveys between April 1964 and March 1967. After 1964 the composition of the inflow remained relatively constant, but the concentration of chloride in the irrigation reach progressively increased and the concentration of sulfate decreased in a downstream direction to values higher and lower, respectively, than in the calcium sulfate type irrigation water from Cedar Bluff Reservoir. The changes were caused mainly by variations in the rate and distribution of groundwater discharge from the district in response to fluctuations in the quantity of rainfall and applied irrigation water. (Knapp-USGS)
W70-02093

STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
Gulf Coast Marine Health Sciences Lab.
For primary bibliographic entry see Field 05B.
W70-02100

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
William A. Berg, and Willis G. Vogel.
USDA Forest Serv Res Pap NE-119, 1968. 12 p.

Descriptors: *Manganese, *Phytotoxicity, *Strip mines, *Legumes, *Plant growth, Hydrogen-ion concentration, Vegetation establishment, Black locust trees, Lespedeza, Spoil banks, Kentucky, Reclamation, Revegetation, Acidic soils, Soil chemical properties, Coal mines, Aluminum.
Identifiers: *Acidic spoils, *Manganese toxicity symptoms, *Strip-mine reclamation, Birdsfoot trefoil, Nodulation.

The occurrence of manganese toxicity was studied on six legume species grown in 46 different acid strip-mine spoils from Kentucky. This toxicity was characterized by a distinct chlorosis on the leaf margins that was readily seen on young leaves of all the species except Kobe lespedeza. Spoil pH was useful in predicting Mn toxicity on the legumes; water soluble Mn extracted from the spoils was not. Korean and bicolor lespedeza seedlings were susceptible to Mn toxicity on spoils with pH below the range of 5.0 to 5.5. Sericea lespedeza in the

seedling stage was also susceptible below this pH range, but on some spoils it outgrew the early toxicity symptoms. Kobe lespedeza, birdsfoot trefoil and black locust did not show Mn toxicity symptoms on most spoils with pH above 4.5. (Vogel-Forest Service)
W70-02209

EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
British Columbia Univ., Vancouver. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-02244

QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
Wisconsin Univ., Madison. Inst. of Plant Development, and Wisconsin Univ., Madison. Dept. of Botany.
G. C. Gerloff, and K. A. Fishbeck.
Journal of Phycology, Vol 5, No 2, p 109-114, 1969. 3 fig, 3 tab, 23 ref.

Descriptors: *Algae, *Chlorophyta, *Cyanophyta, *Nutrient requirements, Analytical techniques, Water pollution effects, Phytoplankton, Plankton, Aquatic microbiology, Cycling nutrients, Essential nutrients, Calcium, Magnesium, Potassium, Harvesting of algae, Limnology, Nutrients, Physiological ecology, Chlorella, Scenedesmus.
Identifiers: *Cations, Draparnaldia, Draparnaldia plumosa, Stigeoclonium, Microcystis, Stigeoclonium tenue, Microcystis aeruginosa, Nostoc, Nostoc muscorum, Absorption, Spectrometry.

Authors evaluated requirements of six species of green and blue-green algae (Chlorella pyrenoidosa, Scenedesmus quadricauda, Draparnaldia plumosa, Stigeoclonium tenue, Microcystis aeruginosa, Nostoc muscorum) for calcium, magnesium, and potassium in terms of critical cell concentrations (CCC) of the three cations. 'Critical cell concentration' is defined as the minimal cell content of an element which permits maximal or near-maximal growth of an organism. As compared with requirements of angiosperm crop plants, calcium needs of all six species were extremely low (CCC 0.06% or less on oven-dry basis); requirements for magnesium were equal to or slightly less than in agiosperms (0.15-0.30%) with exception of Scenedesmus (0.05%); and requirements for potassium varied greatly, from CCC less than average values established for angiosperms (0.25-0.50%) to values equal to or greater than mean values for higher plants (0.80-2.40%). The results suggest differences in physiology and function of cations in the algae studied and in angiosperms which seem worthy of further investigation. (Fitzgerald-Wis)
W70-02245

AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
Vermont Univ., Burlington. Dept. of Botany.
For primary bibliographic entry see Field 02H.
W70-02247

TRISODIUM NITRILOTRIACETATE AND ALGAE,
Ontario Water Resources Commission, Toronto. Div. of Research.
A. E. Christie.
Ontario Water Resources Commission, Div of Research Paper No 2023, June 1969. 11 p, 4 tab, 6 ref.

Descriptors: *Algae, Algal control, Algicides, Aquatic algae, Aquatic microbiology, Bioassay, Chlorophyta, Chlorella, Cycling nutrients, Essential nutrients, Inhibition, Nitrogen compounds, Nutrient requirements, Nutrients, Pollution identification, Sewage, Sewage effluents, Sewage treatment, Water pollution control, Water pollution effects, Water pollution treatment, Detergents, Toxicity, Activated sludge, Eutrophication, Biodegradation, Amino acids.
Identifiers: *Trisodium nitrilotriacetate, NTA, Chlorella pyrenoidosa, Carboxylic acids, Amino carboxylic acids.

Author reports results of preliminary tests to determine the effect of the potential detergent builder, trisodium nitrilotriacetate, on growth of the green alga, Chlorella pyrenoidosa (Ind 395). Increases in nitrogen (N) from 0.14 to 14 milligrams N/liter resulted in threefold increases in cell counts for N either from trisodium nitrilotriacetate or from sodium nitrate. Trisodium nitrilotriacetate in concentration of 275 milligams/liter was not toxic to cultures of Chlorella at an initial concentration of 1 million cells/milliliter. The filtrate of an activated sludge, capable of degrading trisodium nitrilotriacetate, would support the growth of Chlorella. (Fitzgerald-Wis)
W70-02248

DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
Wisconsin Univ., Madison. Dept. of Zoology.
Arthur D. Hasler, and Elizabeth Jones.
Ecology, Vol 30, No 3, p 359-364, July 1949. 1 fig, 4 tab, 6 ref.

Descriptors: *Aquatic plants, *Algae, *Rotifers, Plankton, Bass, Phytoplankton, Ponds, Zooplankton, Minnows, Pedalfers, Scenedesmus, Chlamydomonas, Temperature, Carbon dioxide, Hydrogen ion concentration, Biocarbonates, Dissolved oxygen, Detritus, Bacteria, Water pollution effects, Limnology, Cyanophyta.
Identifiers: *Antagonistic action, *Aquatic macrophytes, Anacharis canadensis, Macrophytes, Potamogeton foliosus, Experimental limnology, Brachionus, Synchaeta pectinata, Polyarthra vulgaris, Karatella cohclearis, Asplancha, Lecane, Bosmina, Navicula, Fragilaria, Cyclotella, Flagellates, Ankistrodesmus, Gomphenema, Spirogyra.

Plants and animals vary greatly in density and species composition and are controlled by extremely complex factors. Macrophytes may have certain competitive advantages over algae when their populations attain specific densities. In experiments reported here, authors aimed at evidence confirming or contradicting previous casual observations bearing on such antagonisms. 'Silo ponds' erected within a large hatchery pond, were densely planted with Anacharis canadensis associated slightly with Potamogeton foliosus. During summer, phytoplankters and zooplankters were counted weekly. Zooplankton of all ponds were subject to similar degrees of predation since each contained 50 fingerling largemouth bass. Fathead minnows were maintained in each pond as food for the bass. Dense growths of aquatic macrophytes in the 'silo ponds' had statistically significant inhibiting effect upon phytoplankton and rotifers, whereas planktonic crustacea were not affected. Growth of bass varied so greatly that it precluded determination of effect of aquatic plants on fish growth. Lists of dominant planktonic genera in planted and control (plant-free) ponds are given. Data on temperature, free carbon dioxide, pH, bicarbonate ion, and dissolved oxygen of experimental and control ponds are reported. (Jones-Wis)
W70-02249

THE OVERALL PICTURE OF EUTROPHICATION,
Texas Univ., Austin. Environmental Health Engineering Research Lab.
E. Gus Fruh.
Journal Water Pollution Control Federation, Vol 39, No 9, p 1449-1463, 1967. 1 fig, 7 tab, 66 ref.

Descriptors: *Eutrophication, Lakes, Organic wastes, Oxygen. Standing crop, Algae, Zooplankton, Fish, Bacteria, Benthic fauna, Photosynthesis, Bioassays, Aquatic weeds, Thermal stratification, Epilimnion, Hypolimnion, Cycling nutrients, Taste, Odor, Color, Turbidity, Hydrogen sulfide, Iron, Magnesium, Cooling, Property values, Recreation demand, Irrigation, Trace elements, Nitrogen fixation, Atmosphere, Groundwater, Watersheds (Basins), Runoff, Phosphorus, Nitrogen, Agricultural watersheds, Forests, Waste water (Pollution), Land management, Copper sulfate, Sodium arsenite, Harvesting, Water pollution, Vitamins.
Identifiers: Shoreline vegetation, Stormwater, Drainage.

Nitrogen and phosphorus, important in plant growth, are subject to control and modification. The immediate question which confronts water quality investigators is whether nitrogen and phosphorus are really the limiting factors in particular aquatic environments which they are investigating. Such determinations can be accomplished by various bioassay techniques. In laboratory cultures of algae, trace elements, previously overlooked, are essential. Likewise, different soils have been added to culture media to supply various necessary organics and growth factors. Today, known vitamins and organic compounds are used. Water quality investigators should determine whether such micronutrients are in sufficient supply in the hydrosphere under various ecological conditions. Knowledge of such facts permits a logical approach for identification of primary nutrient sources. Some nutrient sources, including rainfall, groundwater, and normal watershed drainage, cannot be controlled. If wastewater effluents cause eutrophication, diversion or tertiary treatment can be applied. If agricultural and/or urban drainage are primary nutrient sources, little can, for all practical purposes, be accomplished. Possible economic approaches under investigation in lakes are selective withdrawal of hypolimnetic waters, dilution, aeration of the hypolimnion, and mixing of hypolimnetic waters with the epilimnion. (Jones-Wis)
W70-02251

EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
California Univ., Berkeley. Sanitary Engineering Research Lab.
William J. Oswald, and C. G. Golueke.
Journal Water Pollution Control Federation, Vol 38, No 6, p 964-975, June 1966. 9 fig, 2 tab, 18 ref.

Descriptors: *Eutrophication, *United States, Watersheds (Basins), Bioassays, Productivity, Population, Watershed management, Input-output analysis, Nutrients, Water quality, Tertiary treatment, Waste disposal, Chara, Activated sludge, Effluents, Trickling filters, Irrigation systems, Farm ponds, Reservoirs, Cyanophyta, Bulrush, Synthesis, Sewage, Agriculture, Fertilizers, Industrial wastes, Nitrogen, Phosphorus, Trace elements, Light intensity, Light quality, Water pollution effects, Temperature, Chlorella, Scenedesmus, Euglena, Biochemical oxygen demand.
Identifiers: *Water pollution trends, Assimilative capacity, Algal growth potential, Pithophora, Decay, Flushing action, Algal incubator, Oscillatoria, Anabaena.

Preparation of a materials balance, based on the assimilative capacity and productivity of the body of water and its watershed, is of value in analyzing eutrophication potential. Many natural systems are in equilibrium, particularly when watersheds are less than 50 times larger than its receiving body. For watersheds which are large and heavily populated, eutrophication is inevitable. In watershed management today, no significant effort has been made to balance inputs and outputs. In the future, outputs must be balanced with inputs, must be dispersed, or nutrient addition controlled. If these alternatives are ignored, we will be compelled to sacrifice our precious bodies of water to a vastly accelerated form of the processes of eutrophication. It is possible, by a simple inexpensive bioassay procedure, to evaluate algal growth potential, and consequent eutrophication potential of a water

sample. Such a test may be valuable in determining the degree of eutrophication of a given body of water and to serve as a comparison of eutrophication potential of receiving waters. It may also serve as a basis for comparing bodies of water. (Jones-Wis)
W70-02253

A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
Public Health Service, Cleveland, Ohio.
For primary bibliographic entry see Field 02H.
W70-02254

ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
Johns Hopkins Univ., Baltimore, Md. Dept. of Sanitary Engineering and Water Resources.
For primary bibliographic entry see Field 02L.
W70-02255

FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
Bolivar Labs., Salisbury (Australia).
A. Haughey.
New Zeal J Marine and Freshwater Res, Vol 3, No 2, p 245-261, June 1969. 17 p, 6 fig, 13 ref.

Descriptors: *Algae, *Plankton, *Sewage, *Sewage treatment, *Eutrophication, Ponds, Pollutant identification, Biology, Water pollution, Water pollution sources, Algal control, Bioindicators.
Identifiers: *New Zealand, Sewage treatment pond algae.

Seventeen species of algae, newly recorded between 1965 and 1968 from sewage treatment ponds around Auckland City, are described together with another 11 species found in eutrophic waters of the area. These latter natural waters are often of a transient nature and usually heavily polluted in some way. (Gabriel-USGS)
W70-02304

EFFECT OF pH ON THE RATE OF BOD OF WASTEWATER,
Maryland Univ., College Park. Dept. of Chemistry; Birla Inst. of Tech. and Science, Pilani (India). Dept. of Civil Engineering; and Roorkee Univ. (India). Dept. of Chemistry.
For primary bibliographic entry see Field 05A.
W70-02308

CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES,
Mississippi State Univ. State College. Dept. of Zoology.
Denzel E. Ferguson.
Reservoir Fishery Resources Symposium, Athens, Ga., p 531-536, 1968. 12 ref. Grants from the Agricultural Research Service and US Public Health Service.

Descriptors: *Public health, Resistance, Pesticide toxicity, DDT, Fish genetics, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Pesticide residues.
Identifiers: *Pesticide resistant fish, Mississippi Delta region, Gambusia.

Several species of freshwater fishes from cotton-producing areas of the Mississippi Delta region exhibit resistance to a variety of pesticides. The rate at which resistance evolves, the nature of genetic mechanisms responsible for resistance, and the effects of resistant populations upon natural ecosystems pose challenging problems to fishery biologists. Recent findings suggest that toleration of massive amounts of pesticide residues in tissues of resistant fish represents a hazard to potential consumers, including man. (Sjolseth-Wash)
W70-02315

DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
New Brunswick Univ., Federicton. Dept. of Biology.
G. L. Greer, and U. Paim.
J Fish Res Bd, Canada, Vol 25 (11), p 2321-2326, 1968. 1 fig, 21 ref.

Descriptors: *DDT, *Degradation, Atlantic salmon, Chromatography, Pesticide residues, Chlorinated hydrocarbon pesticides, Metabolism, Pesticide toxicity.
Identifiers: DDE, TDE, New Brunswick.

Atlantic salmon were reared in solutions of DDT. After they died, they were analyzed by thin layer chromatography to determine the pesticide residues. In one experiment three groups of salmon were exposed to three different concentrations (2, 0.1 and 0.01 ppm) of p, p-DDT. Three DDT residues corresponding to DDT, DDE, and TDE were separated from the extracts of each of the three groups of parr. The chromatograms indicated that the parr had taken up considerable quantities of DDT from the suspensions and had degraded a substantial proportion of the DDT to DDE and TDE within 9 hours. Another experiment was designed to test the possibility that some DDT, adsorbed on the external surfaces of the parr, might have been degraded before its adsorption by the parr. It was found that DDT adsorbed on external surfaces of the salmon was not degraded. (Sjolseth-Washington)
W70-02341

SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
Wisconsin Univ., Madison. Dept. of Wildlife Ecology; and California Univ., Berkeley. Dept. of Nutritional Sciences.
Daniel W. Anderson, Joseph J. Hickey, Robert W. Risebrough, Donald F. Hughes, and Robert E. Christensen.
The Canadian Field-Naturalist, Vol 83, No 2, p 91-112, 1969. 4 fig, 5 tab, 65 ref. Funds from Bu Sport Fish and Wildlife, USFWS, and NSF, GB6362.

Descriptors: *Chlorinated hydrocarbon pesticides, *Bird eggs, *Hatching, Birds, Pesticide residues, Pesticide toxicity, Dieldrin, Inhibitors, Metabolism, DDT, Gas chromatography, Fallout, Wisconsin, Gulls, Fertility, Enzymes, Eggshell thickness.
Identifiers: *Polychlorinated biphenyls, *Reproductive physiology, Pelicans, Cormorants, DDE, TDE, Manitoba, Saskatchewan.

Pelican and cormorant breeding colonies in the prairie states and Manitoba and Saskatchewan were used for pesticide studies. The levels of chlorinated hydrocarbons present in eggs and spring food of Double-crested Cormorants and White Pelicans and the effects the residues might have upon the reproductive physiology of these species. Samples were analyzed by gas chromatography. The highest cormorant egg residues were 45.0 ppm of DDE and 28 ppm of Polychlorinated biphenyls (PCB). The highest DDE residues from pelican eggs ran 4.8 ppm and only trace amounts of PCB. Interspecific differences in residues are discussed. A relationship between PCB and DDE residue levels and eggshell deposition was elucidated. The authors feel that the population status of a given cormorant colony can be related to the residues and thus the shell thickness of eggs from that colony. Declining bird populations, reproductive success, and sublethal effects of chlorinated hydrocarbons are discussed. The physiological effects of chlorinated hydrocarbons relating to eggshell formation are discussed. It is felt that the chlorinated hydrocarbons disrupt enzymes activity and thus affect calcium metabolism. (Sjolseth-Washington)
W70-02342

A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
Washington State Water Pollution Control Commission; and Washington State Dept. of Fisheries.
Harry B. Tracey, Ronald A. Lee, Charles E. Woelke, and Gene Sanborn.
Report, Jan 1969. 19 p, 4 tab, 4 ref.

Descriptors: *Bioassay, *Dispersion, *Fish, *Oysters, *Salmon, *Oil, *Toxicity, Oily water, Water pollution, Larvae, Pacific Northwest U.S.
Identifiers: *Dispersants, Steelhead, Hood Canal.

A series of bioassays (using steelhead fingerlings in fresh water, Pacific oyster larvae in saltwater, and coho salmon fingerlings in situ in Hood Canal) and dispersing-evaluation experiments were conducted on 11 oil-dispersants in an attempt to provide applicable information concerning oil-dispersing products to organizations involved in oil spill control in the Pacific Northwest. Group numbers were assigned to each dispersant according to its performance in the toxicity experiments and the dispersing evaluations. In general, dispersants assigned the lower group-number combinations provide the least threat to the aquatic environment and the greatest dispersing efficiency; however, the others may be employed in special cases. (Tyner-Washington)
W70-02343

FISH LOSSES AFTER FOREST SPRAYING WITH INSECTICIDES IN NEW BRUNSWICK, 1952-62, AS SHOWN BY CAGED SPECIMENS AND OTHER OBSERVATIONS,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
C. J. Kerswill.
J Fish Res Bd Canada, Vol 24 (4), p 709-729, 1967. 9 tab, 7 fig, 11 ref.

Descriptors: Atlantic salmon, Brook trout, Insecticides, Fish kills, DDT, Pesticide toxicity.
Identifiers: Forest spraying, Spruce budworm, Malathion, Phosphamidon, Live-box studies, New Brunswick streams.

The survival of young Atlantic salmon and eastern brook trout, held in cages and free-loving was observed in New Brunswick streams inside and outside forested areas sprayed from aircraft with DDT and other insecticides for budworm control. DDT-in-oil in a single application at 1/2 lb/acre caused heavy loss of underyearling salmon and parr within 3 weeks. DDT-in-oil at 1/4 lb/acre had no apparent short-term effects on salmon parr, but killed many underyearlings; two applications 10 days apart were about as harmful as a single application at 1/2 lb/acre. DDD at 1/2 lb/acre and 1/4 lb/acre, and malathion at 1/8 lb/acre, were no more harmful to young salmon than DDT at 1/4 lb/acre. Experimental spraying of phosphamidon-in-water at 1 lb/acre had no apparent harmful effects on young salmon and trout. Observations at a counting fence 12 miles below the lower boundary of the forested area sprayed with DDT at 1/2 lb/acre in 1954 showed extensive killing of suckers and cyprinids. Wild young salmon were found dead in streams when autumn water temperatures approached freezing after June sprayings of watersheds with DDT. (Sjolseth-Washington)
W70-02344

TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
Mississippi State Univ., State College.
Denzel E. Ferguson, and Caroline Chapman Gilbert.
J Miss Acad Sci, Vol 13, p 134-138, 1967. 1 tab, 5 ref. USPHS Grant ES00086.

Descriptors: *Chlorinated hydrocarbon pesticides, *Pesticide toxicity, Frogs, Bioassays, Toads, DDT, Aldrin, Dieldrin, Lethal limit, Resistance, Tolerance.

Identifiers: Toxaphene, Mediam tolerated limit, Intraspecific tolerance variation, Interspecific tolerance variation.

Bioassays of five insecticides with two species of cricket frogs and Fowler's toads from several localities differing in degree of insecticide contamination showed aldrin and dieldrin to be less toxic than DDT and toxaphene. Anuran populations near treated cotton fields exhibited up to 200-fold resistance compared with populations from pesticide-free areas. Population tolerance appeared to reflect environmental contamination and probably history of exposure. Toads were generally more tolerant than cricket frogs. Intraspecific variation in tolerances between populations from pesticide contaminated areas and from non-agricultural areas exceeded interspecific variation in localities presumed to be comparable in history of pesticide contamination. (Sjolseth-Washington)
W70-02345

EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
Connecticut Univ., Storrs. Coll. of Agriculture.
D. Dorfman, and W. R. Whitworth.
J Fish Res Bd Canada, Vol 26, No 9, p 2493-2501, 1969. 1 tab, 27 ref. Partially supported by NSF grant 6P-1819. OWRR Project A-003-CONN.

Descriptors: *Brook trout, *Dissolved oxygen, *Temperature, *Water pollution, Fish, Growth rates.
Identifiers: *Lead, Salvelinus fontinalis.

Slug doses of lead at concentrations of 25 mg/liter administered once a day 5 days/week to brook trout, Salvelinus fontinalis, caused a reduction in growth. Slug doses of 15 mg Pb/liter administered once a day 5 days/week had no apparent effect on the growth of the trout; those trout which received 10 mg Pb/liter (slug dose, 5 days/week) were not adversely affected. There were some interactions with temperature and oxygen concentration. (Tyner-Washington)
W70-02346

MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
Fisheries Research Board of Canada, St. Andrews (New Brunswick).
J. W. Saunders.
J Fish Res Bd Canada, Vol 26, p 695-699, 1969. 1 fig, 10 ref.

Descriptors: *Endrin, *Fishkill, Brook trout, Atlantic salmon, Pesticide toxicity, Bioindicators, Fish behavior, Chlorinated hydrocarbon pesticides, Electro-fishing, Electrical resistance, Fish migration, Resistance.
Identifiers: *Nabam, Mill River, Prince Edward Island, Accidental spillage, Cascumpeque Bay, Delayed mortality.

After accidental spillage of the agricultural pesticides nabam and endrin into Mill River, Prince Edward Island, there were extensive mortalities among brook trout and juvenile Atlantic salmon. Above the spillage site a day after the spill, the trout were apparently healthy while no live trout were found in 2 miles below the spillage site. Some pools contained over 300 dead trout 4 days after the spillage. No live trout were seen in 6 miles of the river. Surviving trout and salmon showed abnormal behavior including unseasonal downstream movements in summer and unusual response to an electrical field. When exposed to an electric field in the water, the trout and salmon fell to the stream bottom. The normal response under natural conditions would have been for them to swim to the anode. The pesticides appeared to have no effect upon eels and sticklebacks were more resistant than trout and salmon. The author proposes that the abnormal behavior could provide a useful biological indicator of pollution by the pesticides. (Sjolseth-Washington)
W70-02347

CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH INCREASED SILT,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. W. Saunders, and M. W. Smith.
J Fish Res Bd, Canada, Vol 22 (2), p 395-404, 1965. 2 fig, 1 tab, 19 ref.

Descriptors: *Silts, Brook trout, Standing crop, Steam erosion, Soil erosion, Scour, Turbidity, Fish populations, Soil investigations, Surface funoff, Fish reproduction.
Identifiers: *Fish survival, Fish size, Ellerslie Brook, Prince Edward Island, Measurement of silt, Fish distribution, Siltation recovery.

Streams on Prince Edward Island contain high silt loads after rains. Ellerslie Brook was studied to determine the changes in a trout population and show the association with increased silt. The sources of silt are described. Summer standing crops of brook trout were determined in various stream sections by mark and recapture. A marked change was noted in the distribution of trout after silting. Trout moved away from silted areas into areas free of silt where normally they would not have been found. A summary of the annual summer standing crops of trout is presented. The association of silting with low standing crops was apparent. Decreased standing crops appeared to result from the destruction of hiding places. The upper brook, where silting was not occurring, had an upward population trend during the same period. The relationship between silting and spawning ground damage is discussed. Following scouring, trout stocks soon increased. The remarkable adaptability of trout to silting, in a habitat with favorable flow and water temperature, was illustrated. (Sjolseth-Washington)
W70-02348

SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLOCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
Mississippi State Univ., State College. Dept. of Zoology.
James R. Gibson, J. Larry Ludke, and Denzel E. Ferguson.
Bulletin of Environmental Contamination and Toxicology, Vol 4, No 1, p 17-23, 1969. 1 tab, 1 fig, 8 ref. Grants ES00086-03 and UI00348-01, US Public Health Service.

Descriptors: *Inhibitors, *Inhibition, Organophosphorus pesticides, Fish physiology, Bioassay, Fishkill, Pesticide toxicity, Monitoring.
Identifiers: *Acetylocholinesterase activity, Parathion.

The practicality of using fish brain acetylocholinesterase (AChE) activity as a monitoring method for pollution was examined. Bluefill sunfish were taken from waters with no organophosphorus insecticide contamination and from laboratory waters containing parathion. Various regions of the brain differ in AChE activity, with the inferior lobe the highest and cerebral hemispheres the lowest. Brain AChE activities in 7 groups of bluegills were determined to study effects of prior treatment upon AChE determinations. One group was a control, 5 groups were subjected to different freezing and thawing procedures prior to examination, and one group was analyzed without the inferior lobe. Significant differences in AChE activity were found depending on the form of prior treatment. They suggest therefore that a monitoring method based upon a 10% depression in AChE activity can lead to erroneous conclusions, even under carefully controlled conditions. Mortality and recovery from organophosphorus poisoning are not necessarily related to the degree of AChE inhibition. AChE activity of a species fluctuates with time. The degree of AChE inhibition is not always related to amount of inhibitor or to length of exposure. (Sjolseth-Washington)
W70-02349

INSECTICIDE-RESISTANT FISHES: A POTENTIAL HAZARD TO CONSUMERS,
Mississippi State Univ., State College.
Denzel E. Ferguson, J. Larry Ludke, Mack T. Finley, and George G. Murphy.
J Miss Acad Sci, Vol 13, p 138-140, 1967. 5 ref. Grant ES 00086, U S Public Health Service.

Descriptors: *Pesticide toxicity, *Food chains, Bioassay, Gas chromatography, DDT, Pesticide residues, Endrin, Resistance, Trophic level, Chlorinated hydrocarbon pesticides, Organophosphorus pesticides, Fishkill, Sunfish, Public health.
Identifiers: *Insecticide resistant fisher, *Insecticide susceptible fishes, Mosquitofish.

This study assessed the acturl and potential hazard of an insecticide resistant population of mosquitofish to large-mouthed bass and green sunfish. When three susceptible large-mouth bass and 14 susceptible green sunfish were fed resistant mosquitofish (about 2 ppm DDT) one bass died after 131 days and sunfish died after 107, 111, and 121 days. The sunfish dying after 107 days had 28.17 ppm DDT. All bass and green sunfish in the control lot fed pesticide free mosquitofish survived. Resistant green sunfish survived after each consumed a live mosquitofish containing 24.93 ppm endrin; susceptible green sunfish died in 15.5 hours. Susceptible green sunfish died 2 hours after consuming live mosquitofish containing 1041.66 ppm endrin. Regurgitation failed to prevent death. The potential hazard of resistant fish to the food chain is described. Biological magnification of insecticides by higher trophic levels is discussed as is the ultimate possible danger to man. (Sjolseth-Washington)
W70-02350

EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
P. F. Elson.
J Fish Res Bd, Canada, Vol 24 (4), p 731-767, 1967. 12 fig, 11 tab, 66 ref.

Descriptors: *DDT, *Pesticide toxicity, Atlantic salmon, Spraying, Fishkill, Persistence, *Fish populations, Electro-fishing, Pesticide drift, Growth rates, Fish harvest.
Identifiers: Spruce budworm, New Brunswick, Parr, Underyearlings, Recovery.

Aerial spraying of DDT resulted in fishkills when some of the spray got into drainage systems. Wild young salmon in unsprayed and sprayed streams were assessed for number in each of 3 size groups (underyearlings, small parr, and large parr), abundance expressed as population index= average number per 100 yards of stream. DDT at 1/2 lb/acre produced underyearling populations only 2-10% as abundant as in non-sprayed areas. Small parr were 30% as abundant and large parr 50% as abundant as in the control areas. DDT at 1/4 lb/acre yielded underyearling populations about 50% as abundant as with no spraying; small parr were 80% as abundant and large parr were affected very little. When DDT was applied twice at 1/4 lb/acre each time, it was followed by low numbers of underyearlings similar to those observed with a single application at 1/2 lb/acre. Downstream transport of the DDT extended the harmful effects 30 or more miles below spray zones. Delayed mortality followed for 4 to 6 months. Reductions in numbers of young salmon were followed by declines in the subsequent adult population. (Sjolseth-Washington)
W70-02351

AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
Wisconsin Univ., Madison. Dept. of Wildlife Management; and Wisconsin Alumni Research Foundation, Madison.
Joseph J. Hickey, J. A. Keith, and Francis B. Coon.
J Appl Ecol, Vol 3 (Suppl), p 141-154, 1966. 10 tab, 28 ref. Supported by Bu Spt Fish and Wildlife and Fish and Wildlife Serv.

Descriptors: *Food chains, *Pesticide residues, Pesticide toxicity, Trophic level, Food pyramids, Bottom sediments, Amphipoda, Gulls, Old squaw duck, DDT, Chlorinated hydrocarbon pesticides.
Identifiers: Green Bay (Wis), Pentoporeia affinis, DDE, TDE.

Organochlorine residues in the Green Bay area of north-west Lake Michigan have been investigated. Analyses have been made of: (1) shallow and deep water mud samples, (2) the amphipod Pontoporeia affinis which is an important food source for fishes, (3) Alewives, Whitefish and Chub, and (4) Old-squaw Ducks, Ring-billed Gulls and Herring Gulls. This preliminary study shows the biological concentration of pesticides previously reported for smaller lakes. In Pontoporeia the concentration factor is about 50 times that of the residue level in mud (DDE increases most), and in fish this factor is increased roughly 10 times more still. Among birds, all of which spent part of their life cycle off Lake Michigan, organochlorine levels were progressively higher in brain, breast and body fat; in Old-squaw Ducks, Ring-billed Gulls and Herring Gulls; and in adult as opposed to younger birds. Body fat averaged 2441 plus or minus 334 ppm of the three compounds in twelve Herring Gulls collected in June and in a seemingly healthy condition. (Sjolseth-Washington)
W70-02353

IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
New Brunswick Univ., Fredericton. Dept. of Biology.
A. D. Cherrington, U. Paim, and O. T. Page.
J Fish Res Bd Canada, Vol 26 p 47-54, 1969. 7 fig, 21 ref. Supported by grants from National Research Council of Canada.

Descriptors: *DDT, *Degradation, Atlantic salmon, Chlorinated hydro carbon pesticide, Anaerobic digestion, Chromatography, Heat treatment.
Identifiers: *Intestinal microorganisms, TDE, DDE, In vitro degradation, Streptomycin.

DDT was added to fresh mid- and hind-gut contents of young hatchery-reared Atlantic salmon to elucidate the conversion of DDT by the alimentary tract contents of Atlantic salmon in vitro. The degradation of DDT at 37 deg C was tested. That the TDE was produced through in vitro degradation of DDT and that saimon gut contents were required for the degradation was inferred from the failure to extract demonstrable amounts of TDE from the DDT-free samples and from controls containing DDT but lacking gut contents. The same experiment was conducted at 10 deg C with similar results. Most of the ability to degrade DDT, attributable to intestinal microflora, was eliminated by streptomycin and by heat-sterilization of the gut contents. The authors suggest that since TDE is less toxic than DDT, the activity of intestinal microorganisms may increase the chances of survival of fish that ingest DDT-contaminated prey. (Sjolseth-Washington)
W70-02354

LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
Fish and Wildlife Service, Bozeman, Mont. Cooperative Fishery Unit; Montana State Univ., Bozeman; and Oklahoma State Univ., Stillwater. Aquatic Biology Lab.
Richard J. Graham, and Troy C. Dorris.
Water research, Vol 2, p 643-663, 1968. (Contribution No 451 from Zoology Dept Oklahoma State Univ). 11 tab, 3 fig, 25 ref. National Institute of Health Research Grant RG-6407.

Descriptors: *Bioassay, *Oil wastes, Oily water, Phenols, Industrial wastes, Chemical degradation, Hydrogen ion concentration, Lethal limit, Dissolved oxygen, Carbon dioxide, Ammonia, Sulfides.
Identifiers: *Low-toxicity effluents, *High-toxicity effluents, Fathead minnows, Condition index.

The effects of oil refinery effluents on fish, when applied for extended periods under conditions of continuous renewal were determined. Toxicity values obtained from long-term tests were compared with those obtained from routine bioassays and it was found that certain wastes cause chronic toxicity. Wastes from 4 refineries were studied so that differences in refining processes and waste treatment methods could be considered. Bioassays of high-toxicity and low-toxicity effluents were conducted. Surviving fish did not appear to suffer adverse effects in sub-acute concentrations of high-toxicity effluents and their behavior and appearance were the same as the controls. High-toxicity effluents had a decrease in toxicity during storage, owing to decreases in ammonia, phenol, and sulfide. Fish were adversely affected by extended exposure to sub-acute concentrations of effluents with low initial toxicity. The difference between low and high toxicity effluents results from the fact that the high toxicity effluents had not been treated in oxidation ponds as had the initial low toxicity effluents. (Sjolseth-Washington)
W70-02355

FISH-LIFE AND POLLUTION IN THE LOWER THAMES: A REVIEW AND PRELIMINARY REPORT,
British Museum of Natural History, London. Dept. of Zoology.
Alwyne Wheeler.
Biological Conservation, Vol 2, No 1, p 25-30, Oct 1969. 1 tab, 1 fig, 12 ref.

Descriptors: *Water pollution control, *Fish harvest, Commercial fishing, Water pollution sources, Water pollution treatment, Fish barriers, Fishkill.
Identifiers: *Thames River, Fish re-establishment.

Commercial fisheries of considerable economic value existed in the tidal reaches of the River Thames, England, until the middle of the nineteenth century. Increasing pollution from industrial and domestic effluents led to their complete destruction and, in the twentieth century, to the virtual absence of a local fish fauna. Recent measures to control pollution have resulted in a partial chemical restoration of the River. Sampling in the lower Thames, by collecting fish caught on the cooling-water intake screens of five electricity generating stations along the River, has shown that fish are present in considerable numbers again. In the period from 28 September 1967 to 31 October 1968, forty-one species were taken. At the farthest upstream point, the majority of fish caught have been freshwater species, while at the farthest downstream station, with one exception, only marine or euryhaline species have been caught. This, and evidence that migratory fish have penetrated through the worst-polluted reaches into relatively clean water, is taken as an encouraging sign of the re-establishment of the fish fauna in the lower Thames. (Sjolseth-Washington)
W70-02356

PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
Maine Univ., Orono.
John B. Dimond, Raymond E. Kadunce, A. Stanley Getchell, and John A. Blease.
Ecology, Vol 49, No 4, p 759-762, 1968. 2 tab, 13 ref.

Descriptors: *DDT, *Persistence, *Crayfish, Pesticide toxicity, Pesticide removal, Pesticide residues, Spraying, Maine, Gas chromatography, Food chains.
Identifiers: DDD, DDE, Spruce budworm, Forest soil residues.

DDT residues were measured by gas chromatography in crayfish collected in streams sprayed a single time but in various past years, in streams sprayed two and three times, and in streams never sprayed, to determine persistence in a natural environment. Residues in the year of treatment ranged from 0.5 to 2.5 ppm. By 2 years after treatment, residues had declined to about 0.1 ppm but remained near this level through 9 years after treatment. Crayfish in unsprayed streams carried uniformly low residues, 0.009-0.014 ppm. Prolonged contamination in crayfish in sprayed watersheds apparently derives from highly persistent soil residues. Ecological significance of these residue levels is discussed. (Sjolseth-Washington)
W70-02357

THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
Eastern Illinois Univ., Charleston. Dept. of Zoology.
L. Stephen Whitley.
Hydrobiologia, Vol 32, p 193-205, 1968. 5 tab, 3 fig, 18 ref. Grant WP 00937-02 (National Institute of Health).

Descriptors: *Bioassay, *Tubificids, Heavy metals, Phenols, Hydrogen ion concentration, Resistance, Alkalinity, Mode of action, Respiration.
Identifiers: *Lead, *Zinc, *Sodium pentochlorophenate, Tubifex tubifex, Limnodrilus hoffmeisteri, Median tolerance limits.

Tubificid worms were shown to be quite tolerant to toxic materials such as lead, phenol, and zinc. Their median tolerance limit (Tlm) for pH levels in modified Knop solution were shown to be 5.8 to 9.7. Their Tlm for lead was 49.0 pp, at pH 6.5 and 27.5 at a pH of 8.5. For sodium pentochlorophenate (PCP) the Tlm was found to be 0.31 ppm at pH 7.5, 0.67 ppm at pH 8.6 and 1.4 ppm at pH 9.5. The Tlm determined for zinc was 46.0 ppm at pH 7.5. The interactions of pH and these substances were examined and discussed, and the importance of definition of the solution was shown. The mechanism of toxicity for lead and zinc probably is the mucousmetal complex which precipitates on the body wall blocking the exchange of oxygen and carbon dioxide. The toxic mechanism of PCP is possibly a biochemical interruption of oxidative phosphorylation. In each instance these experiments show tubificids with a quantitative resistance to lead, zinc and phenol greater than similar resistance recorded for various fish species. (Sjolseth-Washington)
W70-02358

EFFECTS OF DICHLOBENIL ON TWO FISH-POND ENVIRONMENTS,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Oliver Cope, Joseph P. McCraren, and Lafayette Eller.
Weed Science, Vol 17, No 2, p 158-165, Apr 1969. 8 fig, 10 tab, 10 ref.

Descriptors: *Dichlobenils, *Bioassay, Aquatic weeds, Animal pathology, Bottom sediments, Persistence, Fish reproduction, Fishkill, Growth rates.
Identifiers: *Histopathology, Bluegills, Denver, Tishomingo, Oklahoma, Residues, Hematocrits.

Pond studies were conducted at Tishomingo, Oklahoma with 2,6-dichlorobenzonitrile (dichlobenil) and at Denver, Colorado to measure chronic effects on fish and other effects on the ecosystem. Decline of the herbicide was rapid at Tishomingo, with only about 3% of the material remaining after 11 days, while at Denver the herbicide took 3 weeks to reach peak concentration in the water and was still measurable in the water after 189 days. Dichlobenil was present in bottom sediments after 312 days at Tishomingo and after 166 days at Denver. Weeds were controlled at both

locations. No immediate mortality was sustained by fish at either locality, but day-to-day mortality was serious at higher concentrations at Tishomingo. Reproduction apparently was affected by higher dichlobenil levels at Tishomingo. Growth of fish was fastest in ponds treated with highest rates of dichlobenil at Tishomingo, and slowest in the untreated ponds. Residues of dichlobenil developed in fish from all ponds. Some pathology was seen in liver, kidney, and pancreas of Tishomingo fish. (Sjolseth-Washington)
W70-02359

AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
California State Coll., Long Beach. Dept. of Biology.
Robert W. Crippen, and Donald J. Reish.
Bulletin of the Southern California Academy of Sciences, Vol 68, Part 3, p 170-187, July-Sept 1969. 2 tab, 1 fig, 33 ref.

Descriptors: *Annelids, *Bioindicators, On-site data collections, Water analysis, Analytical techniques, Path of pollutants, Dissolved oxygen, Phosphates, Nitrates, Nitrites, Turbidity, Water quality, Water pollution sources.
Identifiers: *Water quality indicators, Polychaetes, Capitella capitata, Los Angeles Harbor, Chlorinity.

A quantitative survey of the polychaetes was made at 28-day intervals from floating docks in Los Angeles Harbor for a 17-month period. Additional data consisted of water temperature, turbidity, chlorinity, dissolved oxygen, phosphates and nitrates--nitrites. Stations were selected according to variations in the degree of pollution. Each station was characterized by at least one unique polychaete. The number of species present at a station decreased as the degree of pollution increased. Capitella capitata comprised an increasing percentage of the total polychaete population from the outer harbor to the inner harbor. Polychaetes were absent from the highly polluted station in the inner harbor. The relationship of the chemical and physical data to the polychaete populations was discussed. (Sjolseth-Washington)
W70-02360

THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
Queen's Univ., Kingston (Ontario). Dept. of Biology.
A. E. Aubin, and P. H. Johansen.
Canadian Journal of Zoology, Vol 47, No 2, p 163-166, 1969. 1 fig, 1 tab, 7 ref.

Descriptors: *DDT, Bioassay, Mortality, Equilibrium.
Identifiers: *Electroencephalograph patterns, *Cerebellum, Goldfish, Acute exposure, Recovery.

Electroencephalograph patterns were recorded for control and test goldfish. Goldfish exposed to 1.0 p.p.m. DDT in water for 2.5 hours show a complete loss of balance as well as an increase in the amplitude and a decrease in the frequency of the spontaneous electrical activity of the cerebellum. After 6 hours recovery in uncontaminated water they recover their balance and the cerebellum electrical activity returns to control levels. The results were compared to the results obtained by other researchers and the need for future investigation is emphasized. (Sjolseth-Washington)
W70-02361

CHRONIT ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
Bureau of Sport Fisheries and Wildlife, Columbia, Mo. Fish-Pesticide Research Lab.
Donald R. Buhler, Mary E. Rasmusson, and W. E. Shanks.
Toxicology and Applied Pharmacology, Vol 14, p 535-555, 1969. 12 tab, 5 fig, 28 ref.

Descriptors: *DDT, *Bioassay, *Pesticide toxicity, Chinook salmon, Chlorinated hydrocarbon pesticides, Pesticide residues, Degradation, Fish physiology, Gas chromatography, Fish diets.
Identifiers: *Fish histopathology, Coho salmon, Kidney degeneration, Chronic toxicity, Ulceration, p,p'-DDT, Technical DDT.

Technical and p,p'-DDT was incorporated into test diets and fed to juvenile chinook and coho salmon for periods as long as 95 days. Pure p,p'DDT was slightly more toxic to young salmon than was the technical DDT mixture. Chinook salmon appeared to be 2-3 times more sensitive to a given concentration of DDT in the diet than were coho salmon. The size of the fish greatly influenced toxicity, smaller younger fish being more susceptible to a given diet than larger older fish. The dose of DDT accumulated within the median survival time ranged from 27-73 mg/kg for chinook salmon and from 56-72 mg/kg for coho salmon. The extrapolated 90-dose LD50 (Hayes, 1967) for young chinook and coho salmon were 0.0275 and 0.064 mg/kg/day, respectively. Liver size decreased on prolonged feeding with DDT, and carcass lipid content was increased. A severe surface ulceration of the nose region appeared in coho salmon fed DDT over long periods. (Sjolseth-Washington)
W70-02362

EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
Yehuda Kott, and J. Edlis.
Sponsored by Mekoroth Water Co. Water Research, Vol 3, p 251-256, 1969. 4 fig, 1 tab, 19 ref.

Descriptors: *Halogens, *Algicides, Chlorine, Algal control, Chlorella, Disinfection, Mortality.
Identifiers: *Kill rates, *Bromine, Iodine, Photo reactivity, Algal metabolism.

Bromine within the concentration range of 0.2 to 1.0 mg/l caused a decrease in Chlorella number after 2 - 5 hr contact, after which time regrowth occurred. A second dose of bromine at the time of regrowth brought about total algal kill. Using chlorine at the same concentration had an algistatic effect, while a second introduction of chlorine had no additional effect at all. Using a mixture of chlorine and bromine solutions caused rapid algal death. Results of halogenation in the dark demonstrated the superiority of chlorine under these conditions. It is assumed that photoreactivity of bromine might be the reason for its better algicidal effects in the light. (Sjolseth-Washington)
W70-02363

EFFECT OF HALOGENS ON ALGAE - II. CLADOPHORA SP.,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
Nachum Betzer, and Yehuda Kott.
Sponsored by Mekoroth Water Co. Water Research, Vol 3, p 257-264, 1969. 7 fig, 5 tab, 8 ref.

Descriptors: *Halogens, Algicides, Cytological studies, Chlorine, Copper sulfate, Algal control, Mortality, Chlorophyll, Algae, Bioassay, Viability.
Identifiers: *Cladophora, Bromine, Filamentous algae, Kill rates, Photo reactivity, Cell color, Cell damage.

Halogenation of natural tufts gave no fruitful results. Using isolated filaments of Cladophora sp. showed that halogens cause changes in cell color from green to yellow or even to colorless, very often damage to cell wall. Leaching of cell content also occurred, or contraction of cytoplasm was observed. Using dark field technique it was observed that the normal red fluorescence seen in healthy cells disappeared. Very high concentrations (50 mg/l and over) caused severe deformation of cells. In the absence of a recommended procedure for measuring viability of filamentous algae, one hundred cells were counted in each filament and a bioassay was performed at the end of each experiment. Addition of 5 mg/l of halogens has caused some effect on the algae, while addition of copper sulphate at this concentration showed no effect at all. With higher concentrations of halogens or copper sulphate, cell damage was caused. Ten mg/l chlorine for 2 hr, 10 mg/l bromine for 10 hr or 10 mg/l copper sulphate for 4 days of contact caused complete algal kill. (Sjolseth-Washington)
W70-02364

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
Yehuda Kott.
Water Research, Vol 3, p 265-271, 1969. 1 fig, 1 tab, 5 ref.

Descriptors: *Halogens, *Algicides, *Bactericides, Chlorine, Chlorella, E. Coli, Resistance, Disinfection, Mortality, Bioassay.
Identifiers: *Cladophora, *Planktonic algae, Bromine, Cosmarium cells, Chroococcus cells.

Bromine in a concentration of 1.4 mg/l was injected for 9 hr during eight consecutive nights into the Jordan channel which is part of the National Water Carrier of Israel. Chlorine and bromine were injected for the same time during two nights, to yield a total of 0.4 mg/l residual. After 15 min contact, coliforms and fecal coli counts showed full correlation between disinfection capacity of bromine under these conditions to that achieved in the laboratory. Cosmarium known to be resistant to chlorine, proved to be sensitive to bromine. Chococcus found naturally in the water was shown to be sensitive to bromination. Chlorella, placed into the channel water in dialysing tubes, showed to react as in previous laboratory experiments. The combined use of chlorine and bromine in field experiment confirmed laboratory results in which higher algal and bacterial kill was achieved with mixtures of halogens than with any one of them separately. (Sjolseth-Washington)
W70-02365

THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
Institutul de Medicina si Farmacia, Iasi (Rumania). Catedra de Igiena.
Simona Apostol.
French, German, Russian and English summaries. Igiena, Vol XIV, No 11, p 663-672, 1965. 3 fig, 20 ref.

Descriptors: *Daphnia, *Benthos, *Toxicity, Zooplankton, Tubificids, Resistance, Water pollution effects, Phytotoxicity.
Identifiers: *Antibiotic toxicity, Bahlui River, Rumania, Cyanophyceae, Chironomidae, Physiological determinations.

Hydrobiologic determinations were carried out in the course of 4 years (1961-1964) studying the plankton and benthos of the Bahlui river at two points, up and down stream of the residual waters of an antibiotic plant. The residual waters containing, besides organic matter, also toxic substances, have a negative influence on the plankton, the most affected being the protozoa and the least sensitive the Cyanophyceae. Accumulation of the organic material at the bottom of the river downstrean of the residual waters brings about the development in the benthos of the saprobic organisms - Tubifexes and Chironomidae larvae. Physiologic determinations - the testing of Daphnia confirmed the toxicity of the waters downstream, especially when in shallow water. (Sjolseth-Washington)
W70-02366

INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
Uniunea Societatilor de Stiinte Medicale Din Republica Socialista Rumania, Bucharest.
Simona Apostol, and Ana Vasiliu.
French, German, Russian and English summaries. Igiena, Vol XVII, No 10, p 627-636, 1968. 6 fig, 15 ref.

Descriptors: *Oxygen demand, *Daphnia, *Bioassay, Dissolved oxygen, Respiration, Animal behavior, Toxins.
Identifiers: *Saponin, *Butyl acetate, *Dibutox, Storage lakes, Oxygen consumption, Mobility.

The use of sensitive tests for appraising the toxicity of storage lakes was studied. To this end, the oxygen consumption of Daphnia magna Strauss under the influence of certain toxic substances was determined, using the Winkler method for dissolved oxygen at 3, 9, 12, 18 and 24 hours, in different saponin, butyl acetate and Dibutox concentrations. In comparison to the controls, the toxic substances tested produced a marked reduction in oxygen consumption. Changes in the respiratory function were noted even at low toxic concentrations at which the survival tests revealed no nocuous influence; no variations were found in the mobility and behaviour of the organism. The Winkler method, applied to study of the first respiratory phase in Daphnia, gave sensitive and reproducible results, and may be introduced in hygiene investigations for determining toxic effects on water organism. (Sjolseth-Washington)
W70-02367

FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
Institutul de Medicina si Farmacia, Iasi (Rumania). Catedra de Igiena.
Simona Apostol, and Ana Vasiliu.
French, German, Russian and English summaries. Revista Medico-Chirurgicala, LXXII, No 3, p 703-710, 1968. 4 fig, 6 ref.

Descriptors: *Daphnia, *Oxygen requirements, Bioassay, Mortality, Phytotoxicity.
Identifiers: *Adaptation, Saponin, Dibutox, Butyl acetate, Oxygen consumption.

Experiments were conducted on the adaptation of Daphnia to different toxic substances under laboratory conditions. The indicator used was oxygen consumption in a group of organisms kept for different intervals in various toxic substances: saponin, dibutox, and butyl acetate, in concentrations in which survival of the Daphnia was of 100%. A tendency of the Daphnia to adaptation to these substances was found, expressed by the proportion of oxygen uptake referred to control values. (Sjolseth-Washington)
W70-02368

THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
Institutul de Medicina si Farmacia, Iasi (Rumania). Catedra de Igiena.
Simona Apostol.
French, German, Russian and English summaries. Revista Medico-Chirurgicala, LXIX, No 3, p 665-671, 1965. 2 fig, 19 ref.

Descriptors: *Bioassay, *Protozoa, Water purification, Lethal limit.
Identifiers: *Formol, *Oxalic acid, *Butyl acetate, *Sulfuric acid, Iassy, Rumania, Bodo genus, Antibiotic manufacturing plant.

In view of the extremely important role played by protozoa in the process of purification of residual waters, the action of the toxic substances eliminated in the residual waters of the Antiobiotic Plant of Iassy on protozoa of the Bodo genus was determined by biotests. Study of the lethal action of the toxic substances in dilutions of 1:10 to 1:100,000 during 60 minutes showed that the strongest noxious effect is that exercised by formol (necessitating a dilution of 1:10,000 to 1:100,000 to lose its toxicity), followed in decreasing order by oxalic acid, butyl acetate and sulfuric acid. Under the purification conditions of the plant certain substances are neutralized in the departments, the greatest danger for the protozoa population which purifies the residual waters being butyl acetate, upon which full attention should be centered. (Sjolseth-Washington)
W70-02369

ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
Yehuda Kott, Galila Hershkovitz, A. Shemtob, and J. B. Sless.
Applied Microbiology, 14 (1), p 8-11, 1966. 4 tab, 3 fig, 16 ref.

Descriptors: *Bioassay, *Halogens, *Growth rates, *Chlorella, Chlorine, Algicides, Algal control, Disinfection, Mode of action, Mortality, Inhibition, Algae.
Identifiers: Bromine, Bromamine, Chloramine.

Chlorella pyrenoidosa was found to grow rapidly in tap water. Peak growth was reached after 2 to 3 days. Chlorine and bromine, added to such water in concentrations of .18 to .42 ppm, were shown to be effective inhibitors of algal growth. Bromine and bromamine were primarily algicidal, whereas chlorine and chloramines were mainly algistatic. It is assumed that the mechanisms of action of these halogens on Chlorella are not the same. The need to investigate the mode of action of these halogens is stressed. (Sjolseth-Washington)
W70-02370

PESTICIDES AND STREAM INSECTS,
Maine Forest Service; and Conservation Foundation, Washington, D.C.
John Dimond.
Bulletin No. 23, Maine Forest Service and The Conservation Foundation, p 1-21, 1967. 3 fig, 5 tab, 24 ref.

Descriptors: *DDT, Maine, *Pesticide toxicity, Pesticide residues, Mortality, Persistence, Diptera.
Identifiers: *Malathion, *Insect population, Spruce budworm, Aerial spraying, Ephemeropter, Odonata, Plecoptera, Trichoptera, Coleoptera, Neuroptera, Recovery.

A two-part study on the effects of malathion and DDT on stream insects was conducted in Maine. In part I, the effectiveness of malathion in controlling spruce budworm and its effect upon stream insects was studied. No changes in the qualitative population structure of streams were noted. Reductions in numbers of dominant insect groups were less than has been reported for DDT except for caddisflies; no effect on stoneflies was noted. The authors state that if at all possible, malathion should be the choice over DDT in insect control programs. In part II the recovery of insect populations in DDT-sprayed streams was investigated. DDT produces marked reductions in the quality and quantity of invertebrate fauna. Larger streams were more seriously affected than the smaller ones. Repopulation occurred within 3 - 4 years. (Sjolseth-Washington)
W70-02371

THE EFFECTS OF HYPER- AND HYPO-CHLORINITIES ON MEMBERS OF THE WOOD-BORING GENUS LIMNORIA,
California State Coll., Long Beach. Dept. of Biology.
D. J. Reish, and W. M. Hetherington, III.
In: International Journal on Life in Oceans and Coastal Waters, 2 (2), p 137-139, 1969. 2 fig, 18 ref.

Descriptors: Chlorination, Isopods, Bioassay, Resistance, Mortality, Water pollution effects, Salinity.
Identifiers: Hyper-chlorinities, Hypo-chlorinities, Limnoria, Burrow length, Tolerance.

The wood-boring isopods Limnoria lignorum, L. quadripunctata, and L. tripunctata were exposed to hypo- and hyper-chlorinities for a 28-day period. Data were analyzed according to survival rate and average burrow length per day. The 50% level was 6.5, 9.5 and 14.5 o/oo at hypo-chlorinities and 27.5, 32.0 and 21.0 o/oo at hyper-chlorinities for L. lignorum, L. tripunctata, and L. quadripunctata, respectively. The average burrow length per day per animal at all chlorinities was highest for L. tripunctata and lowest for L. quadripunctata, with L. lignorum intermediate. (Sjolseth-Washington)
W70-02372

CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
For primary bibliographic entry see Field 05G.
W70-02373

EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
Tennessee Valley Authority, Chattanooga. Div. of Health and Safety.
For primary bibliographic entry see Field 02H.
W70-02411

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
Vanderbilt Univ., Nashville, Tenn. Dept. of Environmental and Water Resources Engineering.
P. A. Krenkel, E. L. Thackston, and F. L. Parker.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, Vol 95, No SA1, p 37-64, Feb 1969. 11 fig, 3 tab, 56 ref.

Descriptors: *Biochemical oxygen demand, *Dissolved oxygen, *Reservoirs, *Thermal stratification, *Waste assimilative capacity, *Water temperature, Degradation, Organic matter, Path of pollutants, Photosynthetic oxygen, Pre-impoundment, Reaeration, Respiration, Soil classifications, Stratified flow, Thermal pollution, Tracers, Waste dilution Waste disposal, Water pollution.

The waste assimilative capacity of streams can be greatly affected by changes in temperature and hydraulic regime caused by impoundment. The increase in depth and decrease in mixing reduce atmospheric oxygenation but provide a more favorable environment for photosynthetic oxygenation. While surface layers remain well aerated, benthal demands and sedimentation of organic material may deoxygenate the lower waters. This effect is accentuated by thermal stratification. The effect of impoundment on all phases of the oxygen balance is considered. References and case studies show that the net effect can be a greatly reduced capacity for waste assimilation. An example calculation also shows that the waste assimilative capacity of a stream below an impoundment is reduced by the peaking action of the hydroelectric plant. (Rietveld-Vanderbilt)
W70-02413

5D. Waste Treatment Processes

SUL-BISUL ION EXCHANGE PROCESS: FIELD EVALUATION ON BRACKISH WATERS,
Elgin International Inc., Ill.
For primary bibliographic entry see Field 03A.
W70-02047

STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
Gulf General Atomic, Inc., San Diego, Calif.
For primary bibliographic entry see Field 03A.

W70-02048

FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
Aerojet-General Corp., El Monte, Calif.
For primary bibliographic entry see Field 03A.
W70-02050

WATER RECLAMATION BY REVERSE OSMOSIS,
Melpar, Inc., Falls Church, Va.
John H. Fossum.
Res sponsored by Aerospace Medical Res Lab. Avail from Clearinghouse as AD-692 720, $3.00 in paper copy, $0.65 in microfiche. Aerospace Med Res Lab Rep AMRL-TR-68-190, Wright-Patterson AFB, Ohio, May 1969. 47 p, 2 fig, 8 tab, 9 ref, 3 append. Contract No F33615-67-C-1534, Proj No 6373, Task No 637304, Work Unit No 637304003.

Descriptors: *Water reuse, *Reverse osmosis, Reclaimed water, Recirculated water, Desalination processes, Semipermeable membranes, Membrane processes, Urine, Thermodynamics.
Identifiers: Spacecraft water reclamation.

A Laboratory reverse osmosis system capable of purifying 4 liters of a mixture of 2.4 liters of urine and 1.6 liters of either wash or dehumidification water in a 24-hour period was fabricated by Melpar, Inc. The quantitative rejection of urea by the membranes was found to be the major problem. Urea rejection by complexing urea with various chemicals was investigated but no significant increase was realized. The effect of storage conditions on membrane performance was investigated. A study was made of the annealing of cellulose acetate membranes and attempts were made to develop satisfactory benzyl derivatives of cellulose acetate. A method was developed which permitted a rapid evaluation of membrane performance. A satisfactory membrane was found to result from the precise control of the annealing process. (Knapp-USGS)
W70-02058

BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
Goodrich (B. F.) Aerospace and Defense Products Co., Akron, Ohio.
For primary bibliographic entry see Field 03A.
W70-02059

AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
Midwest Research Inst., Kansas City, Mo.
Alfred F. Meiners, Elizabeth A. Lawler, Mary E. Whitehead, and John I. Morrison.
Robert A Taft Water Res Center Rep No TWRC-3, Fed Water Pollut Contr Admin Advance Waste Treat Res Lab, Dec 1968. 121 p, 40 fig, 31 tab, 13 ref. FWPCA Contract No 14-12-72.

Descriptors: *Tertiary treatment, *Chlorination, *Chemical reactions, *Ultraviolet radiation, Oxidation, Oxygen demand, Chemical oxygen demand, Organic matter, Nutrients.
Identifiers: Ultraviolet-catalyzed chlorination.

A study was made of the effect of ultraviolet radiation on the rate and extent of chlorine oxidation of organic material in highly nitrified effluents from biological sewage treatment plants. Both oxidation rate and the extent of oxidation by chlorine combined with UV radiation are usually much greater than by chlorine alone. The rate of the catalytic oxidation is dependent upon pH, and rate and efficiency are optimal at pH 5. The average COD decrease at pH 5 was 67% in 5 min, 79% in 10 min and 95% in 15 min. The rate of organic oxidation is not proportional to the chlorine concentration; however, the rate of chlorine consumption is. Large excesses of chlorine do not increase the reaction rate but simply increase the amount of chlorine required to eliminate a given amount of organic matter. The rate and extent of the catalytic organic oxidation at pH 5 are not significantly affected by temperature. Both the rate and extent of catalytic oxidation are substantially reduced by the presence of ammonia in an effluent. Phenol, 2, 4-dinitrophenal, glycine, formic acid, and o-dinitrobenxene are oxidized rapidly and extensively. (Knapp-USGS)
W70-02090

OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
D. Th. A. Huibers, R. McNabney, and A. Halfon.
Rep submitted to fulfill Contract between Fed Water Pollut Contr Admin and Air Reduction Co, Inc. Robert A Taft Water Res Center Rep No TWRC-4, Fed Water Pollut Contr Admin Advance Waste Treat Res Lab, Apr 9, 1969. 62 p, 15 fig, 29 tab, 21 ref. FWPCA Contract No 14-12-114.

Descriptors: *Tertiary treatment, *Ozone, *Oxidation, Chemical reactions, Pilot plants, Oxygen demand, Chemical oxygen demand, Organic matter, Nutrients, Costs.
Identifiers: Ozonation.

Ozone effectively lowers the chemical oxygen demand and total organic carbon content of effluents from wastewater treatment plants. It removes odors and color from water and destroys pathogenic organisms. Tertiary treatment with ozone has the potential of an automated, trouble-free operation with low maintenance. An efficient contacting process and a prelimenary evaluation of its economics were investigated. Ozonation was first studied by low-shear countercurrent contracting in an 18-ft column packed with Raschig rings. Later it was found that the rates of COD and TOC removal could be considerably increased by high-shear contacting using a turbine agitator. The optimum treatment of secondary effluent with ozone required multi-stage cocurrent contacting. A six-stage system was simulated by mixing through the 18-ft packed tower. Overall efficiences as high as 90% were obtained. The estimated treatment cost is 7.7 cents/1000 gal to reduce the COD from 35 mg/l to 15 mg/l assuming an 80% ozone-utilization efficiency in a 10 mgd plant. This is about equal to the estimated cost for treatment with activated carbon. Chemical clarification of the secondary effluent prior to treatment with ozone would reduce ozone consumption and result in a lower final COD and TOC. (Knapp-USGS)
W70-02118

FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
Milwaukee Sewerage Commission, Wis.
Raymond D. Leary, Lawrence A. Ernest, and William J. Katz.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 459-473, Mar 1969. 15 fig, 4 tab, 2 ref.

Descriptors: *Oxygenation, *Activated sludge, *Aeration, Efficiencies, Transfer, Oxygen.
Identifiers: *Diffuser efficiency, *Spiral flow, *Diffusers, Ridge-and-furrow, Longitudinal, Crows foot, Cross flow, Alpha, K-sub L-A, Milwaukee (Wis).

Oxygen transfer tests on seven types of diffuser systems are described, namely; (1) spiral flow (tubes); (2) cross-flow (tubes); (3) ridge-and-furrow; (4) crows foot (plates); (5) modified crows foot; (6) transverse; and (7) longitudinal. The tests were made at Milwaukee's 200 mgd activated sludge plant. The efficiencies showed that a longitudinal system would increase the efficiency over 115 mgd. The spiral flow system in use on East section of the plant. Five parallel rows of porousceramic plates were used to increase the organic removal from the 83% spiral flow to 95%. The increase resulted from more uniform air introduction and lower air loadings per diffuser. (Ledbetter-Texas)
W70-02175

STEEL COMPANY BUILDS FLEXIBLE WASTE-WATER TREATMENT SYSTEM,
Kaiser Engineers, Chicago, Ill.
R. D. Smith.
Water Wastes Eng (Industrial), Vol 6, No 3, p B1-B4, Mar 1969. 2 fig, 2 ref.

Descriptors: *Industrial wastes, *Steel, Coagulation, Iron oxides, Clarifiers, Sedimentation, Vacuum drying, Sludge dewatering.
Identifiers: *Hot strip mill, Iron scale, Modular construction, Make-up water, Softening, Vacuum filtration, Clarifiers, Coagulation aid.

Wastewater treatment facility at Armco Steel Corp. Middletown, Ohio, hot strips mill is described. Iron oxide particles in the wastewater are coagulated, settled, and vacuum filtered. The plant has modular construction to give flexibility of operation to the 100,000 gpm clarification facility. Make-up water (4%) is lime softened. One control panel operates the plant with special monitoring emphasis on pH. (Ledbetter-Texas)
W70-02176

TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
Public Works, Escondido, Calif; and Hirsch and Koptionak, San Diego, Calif.
John A. Williamson, and Lawrence Hirsch.
Water and Sewage Works (Industrial Wastes Supplement) Vol 116, No 7 p IW/24-IW/26, July 1969. 7 ref.

Descriptors: *Industrial wastes, *Reclamation, Economics, Social values, Planning, Nutrients, Desalination.
Identifiers: *Reuse, Esthetics, Conventional treatment, Chemical quality.

The authors briefly describe why industrial waste treatment and reuse are economically justifiable. The treated effluent may be used to supplement other available water. The treatment capabilities are improving to bring about further possibilities in reuse. (Ledbetter-Texas)
W70-02177

OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
Alaska Univ., College. Inst. of Water Resources.
Gareth A. Grube, and R. S. Murphy.
Water and Sewage Works, Vol 116, No 7 p 267-271, July 1969. 4 fig, 2 tab, 5 ref.

Descriptors: *Alaska, *Arctic, *Ditches, Oxidation lagoons, Freezing, Cold regions, Operation and maintenance, Design data, Dissolved oxygen, Nitrification, Temperature.
Identifiers: *Sub-Arctic climate, Operating characteristics, Mixed liquor suspended solids, Suspended solids.

A study was conducted of the operating characteristics of an oxidation ditch in a cold region (Alaska). The effluent dissolved oxygen nitrates and suspended solids, temperature, and the mixed liquor suspended solids were monitored during the winter months. The study was complicated by mechanical breakdowns which resulted from flood damage to the machinery the previous August. The conclusions reached are that BOD removal is not affected significantly by cold weather (90% removal), mechanical problems were not caused by the cold, and nitrate formation is inhibited at temperatures less than 12 deg C and that the oxidation ditch is the most economical treatment for the far north of Alaska. (Ledbetter-Texas)
W70-02178

OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
Federal Water Pollution Control Administration, Washington, D.C.

Robert L. Michel, Albert L. Pelmoter, and Ralph C. Palange.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 335-354, Mar 1969. 11 fig, 40 tab, 6 ref.

Descriptors: *Operation and maintenance, *Wastewater treatment, *Municipal wastes, Costs, Cost comparison, Activated sludge, Lagoons, Trickling filters.
Identifiers: *Per capita loadings, *Construction Grants Program, Federal Water Pollution Control Administration.

The operation and maintenance of the Federally-assisted wastewater treatment plants from July 1962 through December 1964 are described. Tables of operating costs, process variables, practices, and other treatment-related parameters are included. The conclusions reached are the following: (a) per capita values of raw BOD, flow, and suspended solids increase geometrically with population a factor of 2 x of those for 50,000 to 100,000 over those for 5000 to 10,000; (b) operating costs of stabilization ponds are 10 to 16% of those for mechanical plants; (c) sludge digestion contributes a high proportion to treatment costs; and (d) costs will rise sharply with more sophisticated treatment. The most frequent problem of operation and maintenance was the by passing of untreated wastewater. Other problems are also discussed. (Ledbetter-Texas)
W70-02180

BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
Bethlehem Steel Corp., Pa. Homer Research Lab.
Paul D. Kostenbader, and John W. Flecksteiner.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 199-207, Feb 1969. 4 fig, 2 tab.

Descriptors: *Biodegradation, *Activated sludge, *Phenol.
Identifiers: *Coke wastes, *Weak ammonia liquor, Bio-oxidation.

A full-scale plant treats the weak ammonia liquor wastes from the coke plant of Bethlehem Steel Corp (Bethlehem, Pa). The activated sludge plant design was based on research with the wastes. The loadings have been light and the efficiencies high in oxidizing the phenols since started in 1962. Concentrations are reduced by 99.9% to less than 0.1 mg/l in 112,000 gpd. In addition, thiocyanates are lowered by 70% and cyanides have been reduced as much as 90%. (Ledbetter-Texas)
W70-02181

COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
New York State Dept. of Health, Albany; and Washington Univ., Seattle. Water and Air Resources Program.
Stuart E. Smith, and Russell F. Christman.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 222-232, Feb 1969. 10 fig, 17 ref.

Descriptors: *Coagulation, *Pulpwastes, Sulfite liquors, Softwood, Hardwood, Industrial wastes.
Identifiers: *Color removal, *Kraft, *Jar tests, Dosage, Alum, Ferric chloride, Bulking, Papermills.

Alum and ferric chloride can be used to remove color from kraft pulping wastes. Jar tests showed the optimum dosage of coagulant to be linear with the concentration of color with a removal of 2.6 x 10 to the 5th power color units per equivalent of coagulant. With the wastes used, the dosages were the following: alum, pH 5.3 optimun, 150 mg/l for softwood wastes and 300 mg/l for hardwood wastes; ferric chloride, pH 3.9 optimum, 268 mg/l for softwood wastes. Alum and iron are inefficient in removing color from sulfite wastes because of the sulfonate groups. Coagulation of the raw wastes produced a bulking sludge. (Ledbetter-Texas)
W70-02182

PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
Department of National Health and Welfare, Edmonton (Alberta). Public Health Engineering Div.
Robert N. Dawson, and John W. Grainge.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 237-246, Feb 1969. 8 fig, 6 ref.

Descriptors: *Lagoons, *Arctic, *Design criteria, Biochemical oxygen demand, Retention, Outlets, Waste water treatment.
Identifiers: *Canada, *Construction details, Inlets, Aerated ponds, Primary treatment, Secondary treatment.

Four types of wastewater lagoons in cold regions are described: (1) single-cell long retention; (2) primary, short-retention; (3) secondary, long-retention; and (4) aerated. They evaluate each unit for depth, retention time, BOD loading, shape, liquid level, and other parameters. They conclude that single cell, long-retention lagoons are suitable for small plants, 6 to 8 ft deep, 8 to 12 mos retention and 20 lb BOD/acre-day. Primary, short-retention ponds are suitable for the region with design parameters of depth not more than 25 ft, 2 to 4 day retention, and 6 to 9 lb BOD/day-1000 cu ft. Secondary, long-retention lagoons can use some criteria as single-cell except for inlets. They recommend that aerated lagoons be 10 to 20 ft deep, have 30 day retention, and BOD loading up to 0.6 lb/day-1000 cu ft. Construction details, siting, and other factors are discussed. (Ledbetter-Texas)
W70-02183

DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
Vrooman (Morrell), Gloversville, N.Y.
Morrell M. Vrooman, Jr.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 474-481, Mar 1969. 5 fig, 5 ref.

Descriptors: *Safety, *Design, *Regulations, Explosions, Design standards.
Identifiers: *Safety features, Fires, Falls, Asphyxiation.

The accident rates in wastewater treatment plants are 6 times the average frequency for 41 industrial groups. Engineers should design out hazards to lower this rate. They would do well to inquire of the plant operators for delineation of some hazards. Good design can prevent falls, asphyxiation, fires, and explosions. Several actions need to be taken, including: (1) supplement the water pollution Control Federation Manual of Practice No. 1, 'Safety in Wastewater Works,' to expand design for safety features - 'Musts' and electives; (2) promote adoption of Federation Manual design safety by state agencies as regulations; and (3) arrange adoption of applicable sections of the Federation Manual by the National Fire Protection Association and other code formulators. (Ledbetter-Texas)
W70-02184

THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
Division of Isotopes Development (AEC), Washington, D.C.; and Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
D. S. Ballantine, L. A. Miller, D. F. Bishop, and F. A. Rohrman.
J Water Pollut Contr Federation, Vol 41, No 3, Part 1, p 445-458, Mar 1969. 2 fig, 3 tab, 15 ref.

Descriptors: *Sludge treatment, *Radioactivity effects, *Radiation, Disinfection, Stabilization, Costs, Feasibility, Wastewater treatment.
Identifiers: *Ionizing radiation, Refractory pollutants, Destructive oxidation.

Applications of atomic radiations to wastewater treatment are described and the probable costs for such treatments are given. They discuss 4 possible applications; they are as follows: (a) sludge handling and dewatering, (b) destructive oxidation of organics, (c) disinfection, and (d) breakdown of refractory molecules. The radiation sources which were considered are cobalt-60, cesium-137, accelerators, reactor loops, spent fuel elements, and mixed fission products. The estimated treatment costs of $0.13 to $1.58 per 1000 gal are not considered competive for most applications. Sludge beneficiation comes closest to practicality at the present time. (Ledbetter-Texas)
W70-02185

TERTIARY TREATMENT BY MICROSTRAINING,
Cochrane Products Crane Co., King of Prussia, Pa.
E. W. J. Diaper.
Water and Sewage Works, Vol 116, No 6, p 202-207, June 1969. 6 fig, 3 tab, 13 ref.

Descriptors: *Tertiary treatment, *Design data, *Costs, Filters, Stainless steel.
Identifiers: *Microstraining, *Backwash, Filter cloth, Filter runs.

A woven stainless steel cloth around the periphery of a partially submerged drum is used to strain the effluent of waste treatment plants. The drum rotates at a variable speed and the collected mat is backwashed from the top of the drum into a collector. The cloth is available with openings of 60, 35, and 23 microns, but it removes much smaller particles because of the matting. A number of installations are described. The article gives available sizes (to 10 mgd) and costs (installed cost of $24,000 to $45,000 per mgd and operating costs of $2.50 to $4.00 per mg) for microstrainers. (Ledbetter-Texas)
W70-02186

POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
Phillips Petroleum Co., Bartlesville, Okla.
R. W. Klippel.
Water and Sewage Works (Industrial Wastes Supplement), Vol 116, No 3, p IW/2-IW6, Mar 1969. 8 fig, 1 tab.

Descriptors: *Planning, *Pollution abatement, *Industrial wastes, Domestic wastes.
Identifiers: *Petrochemical wastes, *Guayama, Puerto Rico, Sour water, Boiler blowdown, Ballast water, Storm water.

The Core petrochemical complex and satellite industries has a well-planned pollution prevention program. Each industry pretreats its waste then sends the effluent to a centralized secondary treatment plant. The five sewers for the Core facility are: (1) the oily water, (2) the boiler blowdown, (3) the cooling water, (4) the sanitary, and (5) the storm sewers. The nylon fiber plant required sewers (2), (3), and (4). Sour water is separated and skimmed. Runoff receives similar treatment. Ballast water is stripped of the hydrogen sulfide then put into the oily water sewer. Oily water is separated and put back into the harbor. Boiler blowdown water is settled to remove the suspended minerals. (Ledbetter-Texas)
W70-02187

SURFACE AERATION BY MECHANICAL AGITATION,
Rhode Island Univ., Kingston. Dept. of Civil Engineering.
Calvin P. Poon, and Fan-Maw Lee.
Water and Sewage Works, Vol 116, No 7, p 262-266, July 1969. 5 fig, 6 ref.

Descriptors: *Aeration, *Model studies, Dissolved oxygen, Oxygenation, Mechanical equipment, Submergence, Energy dissipation, Depth.
Identifiers: *Agitation, Reoxygenation, Oxygen absorption coefficient, Stirrer, Size of rotor, Rotor speed, Depth area ratio.

Laboratory model aeration tanks were used to study the factors affecting mechanical oxygenation.

The tanks were baffled to prevent swirling of contents. The factors tested were submergence, rotor speed, depth of water and size of rotor. The top of the rotor blades should be at water level for best results. The oxygenation coefficient K-sub a, increases with rotor speed to the 1.5 power to 100 rpm, then at a faster rate. K-sub a is proportional to depth to the minus 1.2 power. At low speeds K sub a is linearly proportional to the ratio of rotor diameter to tank diameter, but is nonlinear at higher speeds. (Ledbetter-Texas)
W70-02188

AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
Tennessee Valley Authority, Norris. Engineering Lab.
Rex A. Elder, Marvin N. Smith, and Walter O. Wunderlich.
J Water Pollut Contr Federation, Vol 41, No 4, p 629-639, Apr 1969. 13 fig, 1 tab, 6 ref.

Descriptors: *Aeration, *Oxygenation, *Jets, Efficiencies, Design data, Dissolved oxygen.
Identifiers: *Cone valves, *Howell-Bunger valves, *Nottely Dam, Tennessee Valley Authority.

Field tests of fixed dispersion cone valves (Howell-Bunder Valve) are described. They report aeration efficiencies of at least 80% for discharge velocities over 30 ft/sec under all conditions of test. The influence of jet thickness was negligible. The valve was located at the end of a pipeline and tested by discharging either freely into the air or into a containment structure. The authors label the device as an excellent aerator. (Ledbetter-Texas)
W70-02189

HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
Maine Univ., Orono. Dept. of Civil Engineering.
Thomas L. Lothrop, and Otis J. Sproul.
J Water Pollut Contr Federation, Vol 41, No 4, p 567-575, Apr 1969. 9 fig, 1 tab, 19 ref.

Descriptors: *Chlorination, *Viruses, *Disinfection, Bacteriophage, Wastewater treatment.
Identifiers: *Inactivation, *Contact time, *Dosage, Poliovirus, Chlorine residual, Combined chlorine, Free chlorine.

Disinfection studies on the type 1 poliovirus and the type 2 bacteriophage were conducted. They used chlorine dossages of 10 to 50 mg/l. Combined chlorine residuals of 18 to 24 mg/l inactivated 99.9% of T 2 phage after 30 min contact. Type 1 poliovirus required 30 to 37 mg/l of combined chlorine for 99.9% inactivation with a 30 min contact (33 to 43 mg/l gave 99.99%). Doses of 4 to 6 mg/l free chlorine removed 100% of T 2 phage and 1 mg/l gave 100% removal of T 1 poliovirus. (Ledbetter-Texas)
W70-02190

ECONOMICS OF WASTEWATER TREATMENT,
Texas Univ., Austin; and Engineering Science of Texas, Inc., Austin.
W. W. Eckenfelder, Jr., and Davis L. Ford.
Chem Eng, Vol 76, No 18, p 109-118, Aug 25, 1969. 8 fig, 7 tab, 5 ref.

Descriptors: *Cost comparisons, *Cost analysis, Tertiary treatment, Activated sludge, Lagoons, Trickling filters, Sedimentation, Skimming, Chemical precipitation, Ion exchange, Neutralization, Biochemical oxygen demand, Chemical oxygen demand.
Identifiers: *Primary treatment, Aerated lagoons, Anaerobic lagoons, Deep well disposal, Suspended solids, Carbon adsorption.

Wastewater characteristics are described from various types of chemical industries, the types of treatments which are likely to be required, and the costs for such treatment units and plants. The costs are related to the initial and final qualities of the wastewater to be treated and to the size of the plants. Curves are shown for the cost of the various unit processes versus size. An example is worked for a conventional activated sludge plant with a daily flow of 2.5 mgd. (Ledbetter-Texas)
W70-02191

KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
Drexel Inst. of Tech. Philadelphia, Pa.; and Stanford Univ., Calif.
Alonzo W. Lawrence, and Perry L. McCarty.
J Water Pollut Contr Federation, Vol 41, No 2, Part 2, p R1-R17, Feb 1969. 10 fig, 4 tab, 26 ref.

Descriptors: *Fermentation, *Methane, *Anaerobic digestion, Design data, Wastewater kinetics, Temperature.
Identifiers: *Volatile acids, *Acetic acid, *Propionic acid, *Butyric acid, Solids retention time, Generation times.

A laboratory evaluation was made of the rate-limiting step of methane fermentation kinetics. An equation to represent the fermentation rate was developed. They found fluctuations from the 'steady-state' volatile acids concentrations. The generation times, as calculated from the Monod coefficients, were 2.2, and 1.9 days for acetic, propionic, and butyric acids, respectively. At a given solids retention time, a decrease in fermentation temperature caused a decrease in treatment efficiency. (Ledbetter-Texas)
W70-02192

HYPERFILTRATION OF PLANT EFFLUENTS,
Oak Ridge National Lab., Tenn.
H. C. Savage, N. E. Bolton, H. O. Phillips, K. A. Kraus, and J. S. Johnson, Jr.
Water and Sewage Works, Vol 116, No 3, p 102-106, Mar 1969. 3 fig, 1 tab, 9 ref.

Descriptors: *Tertiary treatment, *Chemical oxygen demand, *Bacteria, Membranes, Turbidity, Reverse osmosis, Efficiencies.
Identifiers: *Hyperfiltration, *Crossflow-filtration, Porous tube, Ultrafiltration, Filter aid.

Constituents from feed waters deposit a 'dynamic membrane' on porous ceramic tubes. This membrane will accomplish considerable removal of COD, suspended solids, and bacteria. The results of tests on 3 different waters are reported. The COD in lake water (Fort Loudoun Lake) was reduced about 80% when the water was filtered at a rate of 50 gpd/sq ft under a head of 15 atm, from about 30 mg/l to about 6 mg/l. Similar results were obtained for sewage treatment plant effluent, and sewage which had received primary treatment, the latter with filter aid. A decrease in conductivity may be attributable to removal of colloids rather than salts in solution. Application of these experiments are not known at the present, but additional research is warranted. (Ledbetter-Texas)
W70-02193

TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
Havens and Emerson, Cleveland, Ohio.
George D. Simpson, and Lamont W. Curtis.
J Water Pollut Contr Federation, Vol 41, No 2, Part 1, p 151-168, Feb 1969. 6 fig, 4 tab, 18 ref.

Descriptors: *Cost comparisons, *Cost analysis, *Stabilization, *Feasibility.
Identifiers: *Combined wastes, *Stabilization-retention basin sewerage separation, Cleveland (Ohio).

A feasibility study was conducted on a 30,000 acre feet (37 million cubic meter) retention-stabilization basin at Cleveland, Ohio. The basin would hold the combined wastes in a partitioned section of Lake Erie for bio-oxidation, sedimentation and disinfection. The area of the basin would be 900 acres and the average depth 34 feet. The oxidation and sedimentation would be carried out in separate sections. The cost for the basin and collection system would be $83.5 million (1968). The cost of this method of treatment would be about 1/3 of that for separation of the sewer system and treatment by conventional methods. (Ledbetter-Texas)
W70-02195

WASTEWATER TREATMENT,
Water Pollution Control Federation, Washington, D.C.
R. L. Bunch, W. O. Pipes, W. C. Boyle, and S. K. Banerji.
J Water Pollut Contr Federation, Vol 41, No 6, p 907-993, June 1969.

Descriptors: *Reviews, *Surveys, *Annual activated sludge, Trickling filters, Lagoons, Stabilization, Detergents, Anaerobic conditions, Sludge treatment, Sludge digestion, Sludge disposal, Disinfection, Water reuse, Storm runoff, Wastewater, Physical control, Chemcontrol.
Identifiers: *Literature review, Biofiltration, Anaerobic processes, Water reclamation.

The literature in water pollution control for the previous years is reviewed. An eleven member committee gives brief comments on articles in different categories of water pollution. The ten categories with numbers of references in parentheses are as follows: Biological Filters (14), Activated Sludge (53), Lagoons and Oxidation Ponds (57), Detergents (40), Anaerobic Processes (47), Sludge Treatment, Disposal and Utilization (116), Disinfection (26), Water Reclamation and Reuse (91), Wastewater and Storm Flow Treatment (12) and Physical and Chemical Methods (117). (Ledbetter-Texas)
W70-02196

PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
Hercules, Inc., Wilmington, Del. Environmental Services Div.
B. W. Dickerson.
Water and Sewage Works, Vol 116, No 4, p 154-156, Apr 1969.

Descriptors: *Industrial wastes, *Planning, *Design criteria, Neutralization, Skimming, Biological treatment, Coagulation, Emulsions, Organic wastes.
Identifiers: *Zimmerman process, Reaction rate, Catalytic oxidation.

As a result of new regulations, existing plants need upgrading and additional facilities need to be incorporated in new plants. Wastes can upset the well-balanced ecology of a stream. Industrial wastes can be classified under five headings, namely, insoluble and undissolved substances, acid and alkaline discharges, soluble inorganic salts, oils and tars and soluble organic materials. Planning for economical polution control requires a knowledge of the waste characteristics, the assimilative capacity of the stream, and the methods for treatment. The acid and alkaline wastes may be neutralized by the proper chemicals within given reaction times. Organic materials are usually broken down biologically, but the Zimmerman process or calalytic oxidation are also possible. The insolubles may be settled or floated for separation and the colloids and solubles may be coagulated or precipitated to yield insolubles. (Ledbetter-Texas)
W70-02197

EFFECTS OF INSECTICIDES ON ALGAE,
Ontario Water Resources Commission, Toronto.
A. E. Christie.
Water and Sewage Works, Vol 116, No 5, p 172-176, May 1969. 9 tab, 31 ref.

Descriptors: *Algae, *Toxicity, *Insecticides, Metabolism, Radioactivity techniques, Chlorella, Oxidation lagoons.

Identifiers: *Algae toxicity, Carbon-14, DDT, Malathion, Sevin.

A study was conducted of the toxicity and metabolism of DDT, sevin, malathion to cultures of Chlorella pyrenoidosa and algae from a waste stabilization pond. The insecticides in the appropriate solvents were added to culture flasks of algal medium and the number of algal cells counted after various number of days incubation. Carbon-14 tagged insecticides were used to measure uptake and metabolism of the insecticides by algae. DDT exhibited no toxic properties up to 100 mg/l and was only slightly degraded. Sevin is toxic at concentrations above 0.1 mg/l and is not altered appreciably in acidic media. Malathion alters the makeup of mixed culture but is not persistently inhibitory. (Ledbetter-Texas)
W70-02198

CENTRIFUGATION OF WASTE SLUDGES,
Dorr-Oliver, Inc., Stamford, Conn.
Orris E. Albertson, and Eugene E. Guidi, Jr.
J Water Pollut Contr Federation, Vol 41, No 4, p 607-628, Apr 1969. 22 fig, 7 tab, 8 ref.

Descriptors: *Centrifugation, *Sludge, *Dewatering, Cost comparisons, Design criteria, Flow rates.
Identifiers: *Sludge thickening, Solid bowl centrifuges, Long-bowl centrifuges, Pool volume, Bowl speed, Process variables, Feed rates.

Sludge centrifugation with a description of the principles of the centrifuge are reviewed. Results of tests on the solid bowl process variables of feed rate, particle size and density, feed consistency, temperature and chemical aids are reported. The tests were run at 70 sites throughout the U.S.A. on raw primary and secondary sludges, digested primary and secondary pulp and paper wastes and water softening sludges. The results of the tests indicate that a long-bowl centrifuge can handle all types of sludges and can produce a solids concentration as high as or higher than vacuum filters at costs not exceeding those for vacuum filtration. The use of centrifugation for dewatering sludges will increase because of machine improvements. (Ledbetter-Texas)
W70-02199

AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
Oklahoma State Univ., Stillwater. Water Resources Research Center.
Quintin B. Graves.
Available from the Clearinghouse as PB-188 293, $3.00 in paper copy, $0.65 in microfiche. Okla State Univ Water Resources Res Center Rep, 1969. 129 p, 25 fig, 10 tab, 61 ref. OWRR Proj No A-010-OKLA.

Descriptors: *Waste treatment, *Aeration, *Aerobic treatment, *Design criteria, *Equations, Chemical oxygen demand, Biochemical oxygen demand, Sewage treatment, Treatment facilities, Oxidation, Activated sludge, Solids contact process, Biodegradation.
Identifiers: Waste treatment design.

Several recent approaches to design of biological waste treatment systems are evaluated and the equations commonly used for calculating biochemical reactions are summarized and listed. Aerator design, including volume, detention time, air supply, sludge recirculation, and sludge wasting, is given major emphasis. General design criteria are also discussed, and design equations are obtained both empirically and theoretically for use in design and operation of waste treatment plants. (Knapp-USGS)
W70-02234

NON-LINEAR PROGRAMMING AS A METHOD OF DESION OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
Stanford Univ., Calif.
Charles A. Kohlhaas.
Stanford Univ Engineer Thesis, Sept 1969.

Descriptors: *Optimization, *Storm drains, *Treatment, *Mathematical models, Numerical Analysis Computer programs.
Identifiers: *Storm Sewage, *Combined sewers, *Non-linear programming, Sensitivity analysis.

Due to the high flows experienced in combined sewer systems, treatment can seldom be provided for the entire volume of combined sewage. This leads to the problem of determining the optimum-partial treatment needed to meet water quality objectives. Non-linear programming is used to determine the optimum combination of primary and secondary treatment to be provided for combined sewer effluent. Water quality requirements limiting floating solids, grit, settleable solids, suspended solids and BOD are considered as constraints against an objective function composed of the cost of preliminary, primary and secondary treatment. The nature of the problem allows a graphical solution. The sensitivity of the solution to a number of input variables is performed. The response of cost to the levels of water quality specified by water quality regulations is also investigated. The graphical solution of the non-linear program gives insight into the nature of objective and constraint functions encountered in water pollution control work. In spite of the very non-linear nature of the constraint functions in a mathematical sense, the plots of such functions proved to be largely linear.
W70-02243

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
Pittsburgh Univ., Pa. Dept. of Forests and Waters.
Jan C. Phillips, Raphael G. Quimpo, and James P. Miller.
UNESCO, The Use of Analog and Digital Computers in Hydrology, p 661-670, 1969. 10 p, 2 fig, 2 tab, 10 ref.

Descriptors: *Simulation analysis, *Oxygen demand, *Waste water treatment, *Optimization, *Analog computers, Streamflow forecasting, Water quality control, Effluents, Benefits, Waste storage, Synthetic hydrology.
Identifiers: Multiple-degree treatment.

A system consisting of a treatment plant allowing multiple-degree treatment, a synthesized streamflow sequence and storage elements capable of withholding treated effluent for optimal release was simulated in an analog computer. The objective of the study was to develop an analog model of waste treatment plant for meeting water quality standards while maximizing net benefits of waste treatment. The system was operated for different concurrent values of parameters in the Streeter-Phelps oxygen utilization equation to determine the most efficient operating policy. Results were found to be representative of the conditions in large streams of normal velocities. Problems of modeling and simulation were discussed. Refinements on the model were suggested. (Thiuri-Cornell)
W70-02259

DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
Weston (Roy F.), Inc., West Chester, Pa.
Chia Shun Shih, and Pa. Krishnan.
J Water Pollut Contr, Vol 41, No 10, p 1787-1802, Oct 1969. 16 p, 8 fig, 12 tab, 10 ref.

Descriptors: *Dynamic programming, *Waste water treatment, *Industrial wastes, *Optimization, *Pulp wastes, Design, Cost analysis, Engineering structures, Efficiencies, Systems analysis.
Identifiers: Multi-stage treatment plant.

The dynamic programming technique was used for the system optimization of an industrial wastewater treatment design. A serial multi-stage system with two point boundary values was utilized. The objective of the optimization was to identify the optimum combinations and efficiencies of various unit processes in a multi-stage treatment plant meeting the ultimate design requirements. The principles of dynamic programming were reviewed briefly. Then, based on the wastewater treatment design principles, the economic optimization scheme for the plant design was formulated with the integration of dynamic programming techniques. A specific case in pulp and paper wastewater treatment was presented for illustration. The cost functions used in th. example were compiled on the basis of process design and engineering evaluations. Further refinement of the procedure developed in the study to make it a standard design approach was encouraged. (Thiuri-Cornell)
W70-02261

AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A Study of Aerated Lagoon, Activated Sludge and Activated Sludge with Sludge Reaeration in the Treatment of Fruit Cannery Waste,
Snokist Growers, Yakima, Wash.
Larry A. Esvelt.
Available from the Clearinghouse as PB-188 506, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-8, Oct 1969. 135 p, 10 tab, 73 fig, 15 ref, 4 append. FWPCA Program 12060 FAD.

Descriptors: Washington, Industrial wastes, Canneries, *Aerobic treatment, Aeration, Waste treatment, Biochemical oxygen demand, *Activated sludge, Sludge treatment, Oxidation lagoons, Reaeration.
Identifiers: Yakima (Wash), *Cannery wastes, Fruit processing wastes, *Aerated lagoons.

In 1966, it was determined that the Snokist Growers cannery in Yakima, Washington, was in need of further treatment facilities for the cannery waste before the waste could be discharged into the Yakima River. A system of aeration was proposed and a grant sought to aid in construction of facilities and to study the results of the treatment facility following construction. Facility construction proceeded in two stages with addition of an aerated lagoon in 1967 and the addition of additional aeration and clarification facilities in 1968 to complete the treatment system. The treatment system performed more efficiently than initially expected in the original design assumptions, and nearly 99% removal of BOD and COD from the waste stream was accomplished during a major portion of the 1968 processing season. The treatment systems were studied over the two operating seasons, and operated as an aerated lagoon, as an activated sludge treatment system and as activated sludge system but including sludge reaeration. Data was collected on biological substrate assimilation, sludge growth, oxygen uptake and sludge settleability. Constants were obtained from this data. Success of the treatment system is reported and the costs of treatment computed. It is recommended that aerated lagoon treatment be used where 70 percent removal of BOD is desired and suspended solids are permissible in the effluent. Activated sludge treatment is recommended for greater than 90 percent BOD removal and where effluent suspended solids must be minimized.
W70-02284

COOLING WATER CHEMICAL TREATMENTS,
Betz Labs., Inc., Trevose, Pa. Cooling Water Services.
John M. Donohue.
Ind Water Eng (IWE) 1st Annu Air/Water Eng Buyers Guide, p 70, 1969.

Descriptors: *Water treatment, *Cooling water, *Corrosion, *Chemical reactions, *Water reuse, Dissolved oxygen, Pitting (Corrosion), Rusting, Metals, Inhibitors, Silts, Organic matter, Iron oxides, Bacteria, Algae, Fungi, Sulfur compounds, Carbonates.
Identifiers: *Metal corrosion, Cooling water treatment, On-stream desludging.

Corrosion of metals is primarily caused by oxygen that is dissolved in water and then released as the cooling water increases in temperature. The most common types of metal attack are pitting of the metal surface, general wasting away caused by low water pH, and gouging of metal surfaces. Chromate-based treatments are the most effective and widely used of the inhibitors for controlling waterside attack. Cooling water antifoulants are used to prevent deposition of silt, iron oxide, organic matter, and general cooling-water debris. The techniques of on-stream desludging of cooling systems with synthetic polymers have been successfully used in cooling operations. Bacteria, fungi, and algae can interfere with water flow, decrease heat transfer, and accelerate corrosion. Biocides developed and used in cooling systems include organic sulfur compounds, organo-metallics, carbonates, diamines, copper, chlorine, hypochlorites, organic chlorine donors and bromine compounds. (Carstea-USGS)
W70-02294

PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
Vermont Univ., Burlington. Dept. of Agricultural Economics; and Vermont Univ., Dept. of Animal and Dairy Science.
For primary bibliographic entry see Field 05E.
W70-02299

CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTE-WATER EFFLUENT,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Edwin F. Barth, Richard C. Brenner, and Ronald F. Lewis.
J Water Pollut Contr Federation, Vol 40, No 12, p 2040-2054, Dec 1968. 15 p, 4 fig, 7 tab, 25 ref.

Descriptors: *Waste treatment, *Nitrogen, *Phosphorous, *Biological treatment, Sewage effluents, Wastes, Waste water (Pollution), Waste water treatment, Flow, Chemical oxygen demand, Suspended load, Denitrification, Pilot plants, Water quality, Water chemistry.
Identifiers: Chemical waste-processing control, *Nitrogen removal, *Phosphorous removal.

A treatment sequence has been developed which removes approximately 90% of the influent COD, SS, nitrogen, and phosphorus. The modular process consists of high-rate activated sludge, nitrification, and denitrification integrated into a single continuous-flow treatment plant. Each of the three biological unit operations has its own recycle system, so enriched cultures of microorganisms develop. Chemical control is by use of ionic aluminum and methyl alcohol. Data collected on a 185-gpd (700-l/day) pilot plant show removal of 85% COD, 95% SS, 91% nitrogen (all forms), and 92% total phosphorus. (Carstea-USGS)
W70-02310

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,

Warren Litsky, Haim B Gunner, and Ruth Kreplick, Editors. Proc of Inst on Joint Munic and Ind Wastewater Treatment, Framingham, Mass, Mar 5-6, 1969. 187 p, 30 fig, 11 tab, 11 ref.

Descriptors: *Water pollution control, *Waste treatment, *Municipal wastes, *Industrial wastes, *Conferences, Water management (Applied), Model studies, Optimization, Systems analysis, Legislation, Legal aspects, Social aspects, Decision making, Economics, Governments, Planning.
Identifiers: *Industrial-Municipal joint waste treatment.

A conference was held to discuss the technology of joint municipal-industrial waste treatment and water pollution control. Instrumentation, planning, models, and contractual arrangements between industries and municipalities are at an advanced state of development and may be used to solve water quality problems. The topics of discussion include the federal and state roles in pollution control, financial aspects, legal aspects, decision making, treatment technology, research and development, and water management research. (Knapp-USGS)
W70-02319

COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
Burns and Roe, Inc., Oradell, N.J.
A. J. Fiehn.
Journal of the Power Division, Proceedings of ASCE, Vol 95, No Po1, p 55-62, Mar 1969. 5 fig.

Descriptors: *Cooling systems, *Cooling towers, *Cooling water, *Electric power generation.
Identifiers: *Evaporative cooling, Closed circuit, Dry-type, Mechanical draft, Natural draft, Wet-type.

Growth of load centers in semi-arid regions, coupled with the increased cooling demands of large-size modern steam-electric generating units, and with community opposition to the unregulated disposal of waste heat to our natural waterways, prophesies a more widespread application of closed-circuit cooling tower systems. Both wet and dry tower designs, permitting significant reduction in the quantities of power cycle cooling supply, can be expected to gain in popularity despite increased plant investment costs and less favorable operating cycle efficiencies. Details of the wet and dry tower systems utilizing either natural of mechanical draft will determine the relative attractiveness of alternate colsed-circuit tower systems in any particular case. Availability of water supply, size and type of generating unit, i.e. nuclear or fossil fuel, and ambient wet and dry bulb temperatures at the project site have major influences on selection. (Upadhyaya-Vanderbilt)
W70-02396

A COOLING POND PROVES CHEAPER,
Mississippi Power and Light Co., Jackson.
R. W. Braswell.
Electrical World, p 84-85, Nov 30, 1953. 1 fig, 2 tab.

Descriptors: *Cooling pond, *Cooling tower, *Thermal pollution, *Cost comparisons, *Baffles, *Dikes, Evaporation.

An economic study was made during the early design stages of the 210,000 KW outdoor Delta Station near Cleveland, Mississippi. Comparative costs studies indicate that initial construction cost of a cooling pond would be approximately 10% less than the towers. Additional advantages of cooling ponds over cooling towers are that it requires lower maintenance costs and has longer life. Estimates of annual operating expenses indicated a savings of up to 2% in favor of the cooling pond. A divided earth baffle approximately 3,000 feet long and extending out into the pond from the plant side, will provide good utilization of available pond area for evaporative cooling. Slopes were seeded by airplane with rye and bermuda grasses for soil stabilization and prevention of erosion. Maximum forced evaporation from the ponds has been estimated at 9 cfs. Two cfs of seepage losses can be expected. The construction project and cost to date indicate that design studies and estimates were approximately correct. (Upadhyaya-Vanderbilt)
W70-02409

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
Volgograd Agricultural Inst. (USSR).
For primary bibliographic entry see Field 03C.
W70-02424

5E. Ultimate Disposal of Wastes

BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
Geological Survey, Idaho Falls, Idaho.
For primary bibliographic entry see Field 05A.
W70-02072

COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, Feasibility of Connecting Sewage Holding Tanks on Board Recreational Watercraft to a Dockside Collection System and Storage in an Underwater Tank.
Underwater Storage, Inc., Washington, D.C.; and Silver, Schwartz, Ltd., Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-02283

PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
Vermont Univ., Burlington. Dept. of Agricultural Economics; and Vermont Univ., Dept. of Animal and Dairy Science.
C. Lynn Fife, and Kay M. Nilson.
Vermont Univ Agr Exper Sta Bull 658, Sept 1969. 20 p, 3 fig, 6 tab, 12 ref, 1 append.

Descriptors: *Industrial wastes, *Dairy industry, *Vermont, *Byproducts, *Waste disposal, Costs, Water pollution sources, Water pollution control, Costs, Economics, Fertilizers, Foods, Feeds.
Identifiers: Whey, Cheese industry wastes, Byproduct utilization.

The seventeen Vermont cheese plants produced 337 million pounds of whey in 1967. About 69% was the byproduct of low-acid cheeses and 31% the byproduct of high-acid cheeses. Production varied from 40 million pounds in May to 25 million pounds in December. Whey is probably the largest single source of stream pollution in the state. It accounts for about 85% of all industrial pollution and represents a sewage load equal to the domestic wastes of 145,000 people. As of Jan. 1, 1969, legislation prohibits further stream pollution. Forty percent of the whey in the state finds some economic use either as animal feed or fertilizer. Another 20% is handled as sewage but not dumped directly into streams. Annually the industry pays more than $118,000 (above revenues) to handle whey at an average cost of over 5.7 cents cwt. The cost of drying human-grade whey would range from 2.8 to 4.6 cents per pound of powder.. Assembling whey within 40 miles of 80% of production would cost about 1.5 cents per pound, and assembling the rest of the whey in the state would cost from 3.0 to 4.0 cents per pound. Under current price and cost conditions, a large drying plant is feasible if all whey were made available. (Knapp-USGS)
W70-02299

5F. Water Treatment and Quality Alteration

ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
South Dakota State Univ., Brookings. Dept. of Economics.
For primary bibliographic entry see Field 03C.
W70-02051

5G. Water Quality Control

CONTAMINATION OF DRINKING WATER.

R I Gen Laws Ann secs 46-14-1, 46-14-2, 46-14-4 thru 46-14-6 (Supp 1968).

Descriptors: *Rhode Island, *Water pollution control, *Water supply, *Water pollution sources, Consumptive use, Water requirements, Pollution abatement, Lakes, Reservoirs, Ponds, Streams, Public health, Non-consumptive use, Preferences (Water rights), Permits, Administrative agencies, Pollutants, Disposal, Wastes, Legislation, Legal aspects, Water resources, Impaired water quality.

No person shall throw or discharge any sewage, refuse, or other noxious matter into any spring, lake, pond, reservoir, or steam used as a source of water supply for drinking purposes by any political subdivision, institution, or company so as to impair or tend to impair the purity of the water or render it injurious to health. No person shall bathe or wash any animal, clothing, or other article in said waters. Certain irrigational and licensed recreational uses are excepted from this prohibition. The Director of Health may order pollutants which are being discharged into said waters or which are located so that there is danger of pollution to be removed from the premises or he may direct other appropriate steps to be taken to prevent impairment of water quality. The Director may prosecute for all violations of this statute. The Director or other official may seek injunctions against violations of this statute. (Kelly-Florida)
W70-02049

WATER QUALITY STANDARDS SUMMARY.
Federal Water Pollution Control Administration, Helena, Mont.

Fed Water Pollut Contr Admin -- Mont State Water Pollut Contr Counc Coop Rep, Aug 1969. 19 p, 1 fig, 2 tab.

Descriptors: *Water quality act, *Water quality, *Standards, *Montana, Legislation, Water pollution, Water pollution control, Sewage treatment, Interstate, Water utilization.
Identifiers: Montana water quality standards.

During the period of 1958 to 1965 Montana adopted water quality standards for all waters of the State. These standards were reevaluated, modified and strengthened in 1967 under provisions of the Water Quality Act. The State was asked by FWPCA to concur with regard to incorporating as part of their enforceable standards a policy provision to protect existing high quality waters. The approved standards are thus both State and Federal standards, enforceable under the State water pollution control statutes and the Federal Water Pollution Control Act as amended (Section 10). The standards consist of 3 major components: designation of the uses which interstate waters are to serve, specification of narrative and numerical criteria to protect and enhance water quality, and specification of a plan of implementation and enforcement, which includes treatment and control requirements for municipal, industrial, and other wastes discharged to or affecting interstate waters. (Knapp-USGS)
W70-02069

PESTICIDES,
Little (Arthur D.), Inc., Cambridge, Mass.
John Neumeyer, Donald Gibbons, and Harry Trask.
Chem Week, p 37-68, Apr 12, Apr 26, 1969. 64 p.

Descriptors: *Pesticides, Pesticide residues, *Herbicides, Mites, Pest control, Pesticide toxicity, Pesticide removal, Fumigants, Fungicides, Insect control, *Insecticides, Larvicides, Nematocides, Rodenticides, Plant growth regulators, Molluscacides, Biological properties, *Biology, Irrigation operation and maintenance, Agriculture.
Identifiers: Biological sciences, Public Health Service, Department of the Interior, *Department of Agriculture.

Chemical pesticides production has grown rapidly, and forecasts indicate pesticide sales will exceed fertilizer sales by 1975. Several thousand products have been cleared and registered for pesticide use in the U.S., but many are mixtures of 2 or more chemicals or different formulations of the same basic chemical. Approximately 400 important basic ingredients are detailed in a list that gives the product name, producer, chemical name and formula, physical properties, product form, oral toxicity, major use category, and major end-uses. Before a new pesticide is marketed, it must be registered with the U.S. Department of Agriculture and approved by the Food and Drug Administration as to tolerances in or on human food and animal feeds. Other Federal agencies review registrations filed with the USDA when the pesticide products could affect fish and wildlife or human safety. (USBR)
W70-02132

RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION: A REVIEW,
North Carolina State Univ., Raleigh.
For primary bibliographic entry see Field 05B.
W70-02161

ABANDONED MINES.

Pa Stat Ann Tit 52, Sec 809 (1966).

Descriptors: *Pennsylvania, *Water pollution, *Coal mine wastes, *Mine drainage, Coal mines, Mine wastes, Legislation, Mine water, Water pollution sources, Streams, Rivers, Regulation, Mining, Pollution abatement, Public health, Water conservation.

It is the duty of each and every owner, operator, or lessee of any abandoned coal mine which is discharging polluted water which flows into any of the streams or rivers of the state, to seal the entries and air shalfts for the purpose of cutting off the supply of air. (Schram-Florida)
W70-02163

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-02208

AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
Oklahoma State Univ., Stillwater. Water Resources Research Center.
For primary bibliographic entry see Field 05D.
W70-02234

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96th ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.

Available from the American Fisheries Soc. Suite 1040, Washington Bldg, 15th St and New York Ave NW Wash, DC, 20005 for $1.25. American Fisheries Society Special Publication No 4, 1967. 37 p, 14 fig, 83 ref.

Descriptors: *Conferences, *Reviews, *Bioassays, *Dissolved oxygen, *Pesticides, *Water quality, *Water temperature, Aquatic life, Fish populations, Water pollution control, Water pollution effects, Physiological ecology, Toxicity, Legislation, History.
Identifiers: *Symposia, Water quality criteria, Industrial growth.

Recent changes in philosophy and law have broadened the scope of water pollution control from primary considerations of human health to those for the protection of all aquatic life. This publication consists of five articles concerned with acceptable concentrations of pesticides, use of bioassays in pollution research, dissolved oxygen criteria for fish protection, and water temperature criteria for protection of aquatic life. Articles are primarily reviews, with data presented on industrial growth, historical growth of pollution problems, and physiology of aquatic organisms. Attention is paid to definition of terms involved in research in water quality and toxicity. A foreword presents a brief history of water quality legislation, and the symposium is summarized in the final article. (Voigtlander-Wis)
W70-02246

COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
Johns Hopkins Univ., Baltimore, Md.
David H. Marks.
Water Resources Res, Vol 5, No 5, p 1159-1163, Oct 1969. 5 p, 3 tab, 12 ref.

Descriptors: *Water pollution control, *Bypasses, *Pipelines, *Waste water treatment, *Technical feasibility, Dissolved oxygen, Cost allocation, Taxes, Damages, Model studies.

An evaluation of a paper by Graves, et. al., was presented. It concerned the mathematical formulation and solution technique for a problem of using by-pass piping of wastes from more polluted to less polluted areas. Some technical problems were found to originate from the authors' attempts to ranslate the assumptions they had made in modelling and formulating, from the waste treatment alternative model on which they were based, to the by-pass piping problem, which has similar form but different technical underpinning. Another technical issue arose from the use of dissolved oxygen as the only measure of quality in the piping problem. The taxation method suggested by the author for determining how the cost of the solution should be allocated was found to raise a question of quantifying damages and thus establishing levels for charges. Economic research and interpretation was encouraged in the particular area of cost allocation. (Thiuri-Cornell)
W70-02257

REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
Camp, Dresser and McKee, Boston, Mass.

Camp, Dresser and McKee, Boston, Mass, June 1969, 207 p, 32 fig, 25 tab, 21 ref, 8 append.

Descriptors: *Mathematical models, *Water pollution control, *Construction costs, *Drainage systems, *Simulation analysis, Cost-benefit analysis, Optimization, Computers, Water quality control, River flow.
Identifiers: Mixed interger programming.

A method was developed for the determination of a least cost construction program to achieve water pollution control objectives within a drainage basin. The method was to accomplish four specific purposes; (a) to minimize the overall costs based on cost of treatment plants; (b) to provide a method for determining the minimum cost for achieving intermediate goals; (c) to develop a means of determining what water quality improvements could be expected from the expenditure of stated limited funds; and (d) to develop a method which would provide the State and Federal Agencies with clearly defined alternative programs. Simulation programs and a mixed integer programming mathematical model were employed for optimizing purposes. Two independent computer programs were developed which together determined the minimum combination of treatment plants to achieve specified quality standards along the main stem of a river. The Merrimack-Pemigewassett River was selected for the demon-

strative of the usefulness of the proposed method of analysis in a real situation. (Thiuri-Cornell)
W70-02258

SHELLFISH GROUNDS AND PACKING HOUSES.
For primary bibliographic entry see Field 06E.
W70-02268

A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT,
Arizona Univ., Tucson.
Richard Arthur Norling.
M S Thesis, Dept Syst Eng, Univ Arizona, 1969. 86 p, 1 fig, 19 ref, 5 append.

Descriptors: *Systems analysis, *Mathematical models, *Water pollution control, Stream improvement, Dissolved oxygen, Water management (Applied), Standards.

The philosophy and methodology of systems engineering were applied to the complex problem of stream pollution management and the problem of modeling for stream pollution control was examined. A particular criterion of pollution, dissolved oxygen was chosen and a general model was developed in terms of this criterion. The model was programmed and the results discussed. Because of an inability to find valid data for the dynamic case, sample input functions were generated based on Liebman's data (1965) and the results verified manually. The system model that was presented allowed for multiple criteria and transient condition in the stream. A case was made for the use of modeling in terms of general systems theory independent of the pollution criterion used. (Thiuri-Cornell)
W70-02270

COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, Feasibility of Connecting Sewage Holding Tanks on Board Recreational Watercraft to a Dockside Collection System and Storage in an Underwater Tank.
Underwater Storage, Inc., Washington, D.C.; and Silver, Schwartz, Ltd., Washington, D.C.

Available from the Clearinghouse as PB-188 505, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Series, DAST-10, Sept 1969. 75 p, 6 tab, 17 fig, 7 ref.

Descriptors: *Underground storage, Marinas, *Waste storage, Waste disposal, Boats.
Identifiers: Pleasurecraft, Boat holding tanks, *Sewerage collection, *Underwater storage, Pump-out stations.

A pilot plant was designed, constructed and operated to show the feasibility of providing a facility for the collection, storage and disposal of waste from recreational watercraft. An on-board holding tank was installed in each of ten boats for total impoundment of all effluent and for the connection to a dockside sewage collection system through a quick-connect coupling. Each boat was provided with a pump, tank and macerator. At dockside, each boat holding tank was pumped directly into a piped collection system. The dockside collection system was installed with a flexible hose connector at each slip for attachment to the respective boat. The collection system was installed for gravity flow to an underwater storage tank fabricated of synthetic rubber, impregnated with nylon fibers and fastened to the river bed by a system of patented anchors. The underwater storage tank received and held the effluent for periodic discharged by an on-shore pump station to sewage trucks for delivery to a sewage plant. Flow meters were installed at the marina for recording waste flow to the underwater storage tank and amount extracted from the tank. Samples of waste material entering and leaving the underwater storage tank were taken for laboratory analysis. The project demonstrated that on-board storage of watercraft waste and subsequent discharge to an underwater storage tank was effective and economical. This project showed that the discharge of sewage from boats into rivers, lakes, waterways and estuaries could be eliminated.
W70-02283

AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A Study of Aerated Lagoon, Activated Sludge and Activated Sludge with Sludge Reaeration in the Treatment of Fruit Cannery Waste,
Snokist Growers, Yakima, Wash.
For primary bibliographic entry see Field 05D.
W70-02284

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
Federal Water Pollution Control Administration, Washington, D.C.
William J. Lacy.
Available from the Clearinghouse as PB-188 507, $3.00 in paper copy, $0.65 in microfiche. FWPCA Water Pollution Control Research Report, Aug 1969. 167 p, 9 tab, 4 fig. FWPCA Program 12000.

Descriptors: *Industrial water, *Water pollution control, Wastewater treatment, *Water reuse, *Water pollution treatment, Industries water, Quality water requirement.
Identifiers: Industrial pollution control.

The objective of the industrial pollution control R and D program is to develop and demonstrate the required technology to achieve required degrees of pollution control by lease cost methods for all significant industrial sources of pollution. This report includes summaries of 141 research, development, and demonstration efforts necessary to resolve industrial pollution problems. A total of 1200 program efforts are listed in tabular presentation. These projects include the latest developments in physical, chemical, biological, and combinations of treatment methods. It is expected to develop further the cooperation of industry to participate in meaningful pollution abatement demonstrations and to increasingly demonstrate the feasibility of in-plant measures, by-product recovery, and wastewater reuse as methods to abate pollution and to reduce treatment costs. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Research through in-house efforts and by contracts to industries and universities are to complete state of the art studies related to treatment and control technology for selected industry groups. Industrial wastewaters are to be identified, characterized, quantitized, and classified for all industries of pollutional significance.
W70-02285

CENTRIFUGES REDUCE WATER POLLUTION,
Pennsalt Chemicals Corp., Philadelphia, Pa. Equipment Div.
J. R. Townsend.
Ind Water Eng (IWE) 1st Annu Air/Water Eng Buyers Guild, p 66, 1969.

Descriptors: *Water pollution control, *Centrifugation, Water pollution, Sewage effluents, Industrial wastes, Sludge treatment, Suspended load, Sedimentation, Cost analysis, Cost-benefit analysis, Economic efficiency, Economic justification.
Identifiers: Waste water solids removal.

Centrifuges are used to reduce water contamination by removing the suspended waste particles from effluents of paper, meat rendering, plastics or other chemical processing plants. The type of centrifuge used depends upon the effluent composition, the degree of clarity desired and the amount to be handled. The following types of centrifuges are briefly described: Basket-type, perforated-wall, disc centrifuge, and solid-bowl continuous-discharge machines. The comparison of various centrifuges with regard to cost and efficiency should include: original equipment cost, cost of money, period of assumed amortization, capacity of the centrifuge, cost of power, installation cost, plant space, manhours required to clean the centrifuge, and personnel costs. (Carstea-USGS)
W70-02295

SURFACE AERATION,
Permutit Co., Paramus, N.J. Pollution Control Applications.
E. D. Driscoll.
Ind Water Eng (IWE) 1st Annu Air/Water Eng Buyers Guide, p 47, 1969.

Descriptors: *Aeration, *Oxygen, *Waste water (Pollution), Biological treatment, Activated sludge, Sludge digestion, Equations, Mixing, Suspended load, Waste treatment, Temperature.
Identifiers: *Surface aeration, Surface aerators.

Atmospheric oxygen can be added to water or waste water by using surface aerators. These devices are often used in biological waste treatment systems, activated sludge systems, aerated lagoons, and aerobic sludge digestion. The purpose of aeration is to furnish the necessary oxygen, maintain the biological solids in suspension, and produce the necessary thorough mixing of oxygen, waste water, and biological solids. Surface aeration is the most efficient technique currently available for introducing oxygen, and the transfer efficiency depends on temperature, oxygen concentration in the system, and characteristics of the waste. An equation for calculating the amount of oxygen transferred at any conditions other than 'standard' is given. (Carstea-USGS)
W70-02296

WATER MANAGEMENT - A NEW WAY OF LIFE,
Dravo Corp., Pittsburgh, Pa. Dept. of Water and Waste Treatment.
E. Stuart Savage.
Ind Water Eng (IWE) 1st Annu Air/Water Eng Buyers Guide, p 36-37, 1969. 2 p.

Descriptors: *Water management (Applied), *Waste treatment, *Industrial wastes, Water sources, Water supply, Water treatment, Water conservation, Water reuse, Water control, Industrial water.
Identifiers: Industrial water management.

The problems of water management, particularly in the field of industrial waste treatment and control, are many. Industry currently accounts for half of the total water use in the United States and this is expected to increase to 65% by 1980. Industry discharges twice as much waste into waterways as municipalities. Very briefly, water management does the following: (1) develops a water source; (2) treats water for use; (3) considers water conservation, recirculation and reuse; and (4) treats wastes and reclaims usable water. Basically, water management consists of planning, organization, implementation, control. All these factors should be given equal consideration in a good water management program. (Carstea-USGS)
W70-02297

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and Washington Univ., Seattle.
Denny S. Parker, and James A. Crutchfield.
Water Resources Res, Vol 4, No 2, p 233-246, Apr 1968. 14 p, 9 fig, 1 tab, 6 ref.

Descriptors: *Water quality control, *Water quality, *Water management (Applied), *Economics, *Cost-benefit analysis, Water pollution control, Water demand, Planning, Water resources, Water pollution, Water conservation.

Identifiers: Time profile of benefits, Time profile of costs.

Economists, in evaluating the long-term benefits in public works projects, have traditionally held that long-term benefits will contribute very little to the total present worth of the benefits accrued over the life of the project. It is shown, however, that the long-term social cost resulting from projects that cause water pollution cannot be neglected or assumed away in the host of practical cases where 'amenity' demands for good water quality in a project's area of influence are significant. (Carstea-USGS)
W70-02311

INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
Idaho Operations Office (AEC), Idaho Falls. Health Services Lab.
For primary bibliographic entry see Field 05B.
W70-02321

CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.
M. Rebhun, M. A. Fox, and J. B. Sless.
The Jerusalem Conference for Water Quality Research, p 1-8, 1969. 5 fig, 10 ref.

Descriptors: *Odor-producing algae, *Taste-producing algae, Algae, Chlorination, Water quality control.
Identifiers: *Oscillatoria, National Water Carrier (Israel), Threshold odor numbers.

Seasonal appearance of blue-green algae (Oscillatoria spp) produces earthy odors and tastes in the water of the Tsalmon and Beth Natufa reservoirs of the National Water Carrier. Field trials, in which water from these reservoirs was chlorinated, showed that chlorination was not completely effective as a means of controlling the earthy odor, although a reduction of the odor level was always observed, when the earthy odor was the sole odor present in the water. A model system employing a species of Oscillatoria, was used to provide samples of water having different levels of threshold odor, and the effect of chlorination investigated. It was found that chlorination reduced the initial odor to an asymptotic value which proved to be directly proportional to the initial odor level. They concluded that complete control of the earthy odor produced by Oscillatoria is not feasible by use of chlorine alone, but that odor levels may be reduced by chlorination to an extent where other methods (such as dilution) are more readily applicable. (Sjolseth-Washington)
W70-02373

COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
American Society of Civil Engineers, New York.

Available from the Clearinghouse as PB-188 511, $3.00 in paper copy, $0.65 in microfiche. Department of the Interior, Federal Water Pollution Control Administration, Wash, DC, Oct 1969. 198 p, 22 tab, 52 fig, 95 ref. FWPCA Program No 11020 EKO, Contract No 14-12-29.

Descriptors: *Pressure conduits, *Sewers, *Flow separation, *Pollution abatement, *Waste water disposal, *Pumping, Sewage disposal, Pumping plants, Pipeline, Separation techniques, Hydraulic conduits, Drainage systems, Storm drains, Storm runoff.
Identifiers: *Sewer separation, Sewer-in sewer, *Waste grinders.

A new concept for separating wastewater from stormwater drainage in combined sewer systems was investigated and reported. Separation is desirable to abate pollution of basements and streams from sewage backups and overflows during periods of heavy stormwater flow. Twenty-five technical reports and memoranda evolving from this project, together with field testing of the concept, constitute the background for the report. The concept involves pulverizing and pumping sewage from buildings through pressure tubing threaded through building sewer lines. These, in turn, connect with pressure conduits inserted within existing street sewers designed to carry both wastewater and stormwater to interceptor sewers. The feasibility of the concept was confirmed and most of the required equipment and materials are available. Pressure conduit can be installed inside street sewers large enough to accommodate workmen. The costs of constructing, operating and maintaining flow-separation systems as envisioned are estimated to be substantially greater than costs of constructing separate wastewater sewer systems. Other applications of the concept, involving the transportation of wastes in pressure tubes and conduits within utility tunnels, may be of greater practical use than that of separating wastewater from stormwater. (Poertner-Chicago)
W70-02392

CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
Tennessee Valley Authority, Chattanooga.
M. A. Churchill.
Symposium on Streamflow Regulations for Quality Control, US Public Health Service, Cincinnati, Ohio, Apr 3-5, 1963. Mss 21 p, 8 fig.

Descriptors: *Temperature control, *Reservoirs, *Tennessee River, Tennessee Valley Authority Project, Temperature, *Thermal stratification, Thermocline, *Thermal pollution, Density currents, Density stratification, Cooling, Cooling water, Reservoir operation, Impoundments, Hypolimnion, Epilimnion.

The effect on downstream temperature below a reservoir because of water release from low-level outlets or high-level outlets is discussed. If water is released through low-level outlets significant effects during the warmer months can result. Conversely, if water is released through high-level outlets, the reservoir may have little effect on water temperature. Thermal stratification occurs in a reservoir during the warmer months and density currents can be observed. A beneficial use of density underflows is for cooling of waters for steam condensing purposes in large steam-electric powerplants. Data are presented, observed in, and downstream from, certain impoundments operated by TVA. The data were collected over a period of approximately 26 years. (Novotny-Vanderbilt)
W70-02407

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
For primary bibliographic entry see Field 03C.
W70-02419

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
All-Union Scientific and Research Inst. of Hydrotechnics and Reclamation, Moscow (USSR).
O. G. Grammaticati, and Z. D. Polikarpova.
International Congress of Soil Science, 9th, Adelaide, Australia, Transactions, Vol 1, p 465-472, 1968. 1 tab, 4 fig, 4 ref.

Descriptors: *Arid lands, *Alkalinity, *Soil water, *Groundwater, *Mulching, Cotton, Lysimeters, Sierozems, Irrigated land, Soil chemical properties, Crop production, Chlorides, Sodium, Saline water.
Identifiers: *Uzbeck SSR, *USSR.

Under arid conditions, even when irrigation is employed, plants may utilize fresh groundwater which is sufficiently near the surface. As the salt content of such water rises, plants have greater difficulty in using such water and at some point it becomes impossible. The authors report a lysimeter experiment with cotton plants conducted in the Uzbeck SSR on meadow sierozem soils. Polyethylene film was used as a mulch to retard the rise of salts through evaporation into upper soil layers. Fresh groundwater was used as a control and mineralized groundwater in the other lysimeters had 20 grams/liter of salts. The mulch successfully prevented the salt movement in the soil and salt accumulation in the surface layers. Surface chloride content in the mulched plots was one-seventh that of the unmulched plots. The average yield of cotton in the mulched plots was substantially higher than in the unmulched and was essentially equal to the yield from the fresh water control. (Crouse-Arizona)
W70-02432

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
Battelle Memorial Inst., Columbus, Ohio.
Neil L. Drobny.
Fourth Amer Water Resour Conf, Proc Ser No 6, Amer Water Resour Ass, p 534-558, 1969. 25 p, 3 fig, 1 tab, 45 ref.

Descriptors: *Operations research, *Optimization, *Systems analysis, *Mathematical models, *Water management (Applied), Water resources, Water resources development, Planning, Decision making, Optimum design, Simulation analysis, Linear programming, Dynamic programming, Queueing theory, Markov processes, Bibliographies.
Identifiers: Water resources engineering, Water resources management, Deterministic model, Stochastic models.

Mathematical modeling techniques and applications to the design and analysis of water resources systems are explained. The discussion concentrates on basic concepts and features of water resources systems amenable to study by mathematical methods. Mathematical details are avoided and emphasis is placed on model structure. A comparison is made of the general classes of mathematical models: (1) performance vs optimization models; (2) deterministic vs stochastic models; and (3) analytical vs simulation models. The categories are not mutually exclusive. Specific techniques are explained and sample applications given. Optimization methods include linear programming, quadratic programming, and dynamic programming. Stochastic modeling is discussed in regard to statistical decision theory, queueing theory, inventory theory, and Markov processes. Simulation models are discussed. (USBR)
W70-02151

ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
Water Research Association, Medmenham (England).
M. J. Burley, and J. A. Cole.
UNESCO, The Use of Analog and Digital Computers in Hydrology, p 584-590, 1969. 5 p, 4 fig, 1 tab, 11 ref.

Descriptors: *Reservoir operation, *Water resources, *Multiple-purpose reservoirs, *Hydrologic aspects, *Dynamic programming, *Digital computers, Optimization, Impoundments, Desolination, Economic feasibility, Operating costs.
Identifiers: Linked water resources.

The efficient employment of linked water resources was discussed. The study viewed the subject of linked water resources from two main aspects: (a) the computational problem of operat-

ing two linked storages optimally for any given hydrology, given capacities and fixed economic parameters of operation; (b) the conjunctive use of a desalination plant and surface water impoundment, at a given deficit risk. The objective of the study was to formulate an optimal rule which would be used to guide the operation of linked reservoirs and make the best use of different hydrological and economic characteristics of each component of the linked system to ensure efficient employment of linked water resources. Two examples, one for each of the main aspects of linked water resources were discussed. A dynamic programming approach and a search method were employed for finding the minimum operating cost combination of reservoir contents and preceeding inflows and for deciding at what reservoir contents the desolation plant should begin to operate. A digital computer facilitated the formulation of month by month control rules. (Thiuri-Cornell)
W70-02256

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
Utah Water Research Lab., Logan.
Murland R. Packer, J. Paul Riley, and Eugene K. Israelsen.
UNESCO, The Use of Analog and Digital Computers in Hydrology, Vol 2, p 386-391, 1969. 6 p, 4 fig, 7 ref.

Descriptors: *Simulation analysis, *Hydrologic properties, *Economic efficiency, *Resource allocation, *Water management (Applied), Optimization, Analog computers, Model studies, Benefits, Water values.

Detailed optimum use considerations in terms of economic efficiency in water resource planning and management using the simulation technique were presented. The Cache Valley, Utah was chosen for simulation in the study. Simulation of an actual hydrologic-economic system synthesized fundamental hydrologic and economic processes into a working model. Water values were investigated by directing water to various alternative uses from a particular phase of agriculture. The resulting change in net benefits both to the system as a whole and to individual sectors of the economy were observed. The analog computer was used to develop a model of the system and to examine the related parameters and the effect of management changes. (Thiuri-Cornell)
W70-02264

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
TRW Systems Group, San Bernardino, Calif.
M. L. Frankel, and J. A. Beaver.
UNESCO, The Use of Analog and Digital Computers in Hydrology, p 431-438, 1969. 8 p, 1 fig, 4 ref.

Descriptors: *Water resources development, *Resource allocation, *Analytical techniques, *Simulation analysis, *Mathematical models, Operations research, Systems analysis, Cost-benefit analysis, Planning, Water managment (Applied).

The use of operations research techniques for water management was discussed. A classification scheme was described in the study whereby the specific conditions and problems of a region can be related to the existing body of analytical tools; computer simulation and mathematical programming. In order for the planners and managers to derive maximum benefit, the study identified the classification of analytical tools and the management study organization in terms which related readily to the problems of regional resource management. Simulation merely enabled the observation of a system under a particular operating strategy. Mathematical programming techniques were widely used in static and dynamic resource allocation problems. The use of the techniques was aimed at the allocation of limited resources while maximizing benefits or minimizing costs. The management of water resources in the San Bernardino Valley was reviewed as an example. (Thiuri-Cornell)
W70-02265

SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and Texas Water Development Board, Austin.
Donald E. Evenson, and Joe C. Moseley.
Rep, Nat Sci Found Short Course Water Resources, N Mex State Univ, Las Cruces, June 1969. 17 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Simulation analysis, *Optimization, *Multiple-purpose projects, *Water resources development, *Planning, Routing, Mathematical models, Hydraulic properties, Network design, Systems analysis.
Identifiers: Stage Development Model.

A set of simulation and optimization tools capable of analyzing the development and operation of a complex, multi-basin, interconnected water resource were explained. Three basin models were developed: (a) a simulation procedure, employing a direct solution of a set of linear equations and an optimization program were used to describe the hydraulic behavior and to compute incurred costs; (b) a network flow code, the Out-of-Kilter Algorithm was used in an optimization model to determine the best reservoir operating rules and the least cost flow routing; and (c) a Stage Development Model incorporated response surface exploration using random sampling and the method of successive perturbation to select the development plan for having the least overall present value. These models provided valuable information regarding the questions: (a) 'When should new projects be built'; (b) 'How big should they be'; and (c) 'How should the system be operated'. These tools were tested on the Texas Water System in order to assure their applicability to the real-world problems. (Thiuri-Cornell)
W70-02266

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
Battelle Memorial Inst., Columbus, Ohio.
H. R. Hamilton, S. E. Goldston, D. C. Sweet, N. M. Kamrany, and R. D. Schultz.
Susquehanna River Basin Utility Group, Battelle Memorial Inst, Columbus, Nov 1964. 34 p, 10 fig, 10 tab, 12 append.

Descriptors: *Dynamic programming, *Mathematical models, *River Basins, *Economic feasibility, *Simulation analysis, Constraints, Economic production, Computers, Growth rates.

The report outlined the progress made in the Phase II of the overall research effort toward the development of a dynamic, mathematical model of the economy of the Susquehanna River Basin. Phase I had investigated the feasibility of building a dynamic model. Phase II was directed primarily toward analyzing and tying together factors judged to have significant impact on the growth of the economy of the Basin. The dynamic model was adopted for computer simulation and used to make projections of the economy of the Study Area until the year 2010. To estimate the economic input of constructing alternative sets of river works in the Basin, a 'Moderate' and an 'Elaborate' set of works were hypothesized and the economic consequences simulated by the model. It was concluded that water was not a constraint upon the growth of the economy of the Susquehanna River Basin. (Thiuri-Cornell)
W70-02272

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
Massachusetts Inst of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-02286

STOCHASTIC PROCESS OF PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02B.
W70-02298

MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
Colorado Univ., Boulder.
Ayers Brinser.
In: Economics of Watershed Planning, p 70-83, Iowa State University Press, Ames, 1961. 14 p.

Descriptors: *Watersheds, *River basin development, Water management, Water resources development, Economics, Planning.
Identifiers: *Watershed development, Basin development.

The problem of adjusting watershed development to river basin development can be greatly reduced by the continued refinement of the tools for measuring the input-output relationships in water resource management. These in turn will help to reduce the area of uncertainty and support investment decisions. To be useful, however, in developing an optimum basin program, the economic data have to be fitted into a planning process that will relate predictable economic consequences to political and social values. This assumes that the optimum is an emerging objective that is approached by contingent solutions sufficiently flexible to respond to change. Programs for river basin development are still in their formative stage. The fact that each basin has its own range of possibilities suggests that there may be no one program for such development. For these reasons, a close scrutiny of going watershed programs that are in early stages of basin development may provide a useful insight into the essential planning process by which water resource management may be guided toward social objectives as time and circumstances define them. (See W70-02374). (Loeb-Rutgers)
W70-02379

PROGRAMMING STRUCTURES IN WATERSHED DEVELOPMENT,
Oregon State Coll., Corvallis.
Emery N. Castle.
Economics of Watershed Planning, p 167-178, Iowa State University Press, Ames, 1961. 12 p, 3 fig, 6 tab.

Descriptors: Watersheds, Linear programming, Computers, Water utilization, Costs, Irrigation, Benefits, Risks.
Identifiers: *Programming, *Watershed development, Activity analysis, Capacity.

Activity analysis or linear programming is suggested as a promising aid in watershed planning in view of the large number of interdependent variables that may be involved. This paper is a progress report on research that uses activity analysis to help solve watershed planning problems. In the problems presented, the number of variables has been limited to permit a better comprehension of the approach. The capacity of computers is such that the number of variables may not be a major obstacle, once problems are formulated adequately. Even if activity analysis does not lead to better projects directly, there may be a substantial indirect benefit. The method provides a framework through which economics and engineering can be integrated. In view of the interdisciplinary aspect of water research, this additional benefit is considerable. (See W70-02374). (Loeb-Rutgers)
W70-02383

THE TIMESCALE OF ECONOMIC MODELS: HOW LONG IS THE LONG RUN,
St. John's Coll., Cambridge (England).
A. B. Alkinson.

The Review of Economic Studies Vol XXXVI, No 106, p 137-152, Apr 1969. 16 p, 16 ref.

Descriptors: *Model studies, *Capital, Equilibrium, Technology, Economic analysis, Mathematical studies, Labor, Income, Prices, Costs, Profits, Population.
Identifiers: *Timescale, *Cyclical growth, Factor shares, Elasticity of substitution, Depreciation, Capital-output ratio.

The author is interested in showing how an analysis of the timescale of economic models may provide valuable additional information. Three different models of economic growth are examined. The first is that of a one-sector economy where there is non-neutral technical progress. In such an economy, one of the factor shares tends asymptotically to zero and the author examines the time path of this movement. A model with heterogeneous capital is examined in an attempt to throw some additional light on current problems. A model of cyclical growth is examined as well as the period of growth cycles generated by this model. Considerable use is made of numerical methods of analysis, in particular in solving differential equations. The widespread use of economic models in the water resource area make an understanding of the timescale vital to the water resource planner. (Murphy-Rutgers)
W70-02385

LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS,
Jacob T. Schwartz.
New York, Gordon and Breach, 1961. 282 p.

Descriptors: *Mathematical models, *Leontief models, Mathematical studies, Analytical techniques, Economics, Prices, Statistics.
Identifiers: *Mathematical method, *Analytical economics, Business cycles, Consumption, Say's Law, Keynesian economics, Multiplier, Liquidity preference, Neoclassical equilibrium, Walrasian equilibrium, Propensity to consume, Matrices.

This volume is composed of a series of lectures in mathematical economics. The author has attempted to put economics in the foreground and mathematics and mathematical rigor in the background. The volume begins with the Leontief input-output model which develops as a general framework for all that is to follow. After an introductory treatment of price theory in the Leontief model the author continues with a discussion of business cycle theory, and develops the connection between cycle theory and the equilibrium analysis that is commonly called Keynesian. The author concludes with a critique of the 'general equilibrium' approach of Walras, attempting to bring notions of Walras and Keynes to an unbiased confrontation. Of particular interest to the water researcher is the first part of this volume dealing with input-output analysis. These models have recently been applied to water area problems in the western states. For example, see the study of H. Craig Davis, Economic Evaluation of Water, Part V, Multiregional Input-Output Techniques and Western Water Resources Development, Contrib. 125, Univ. California, Feb 1968. (For abstract see SWRA, Vol 1, No 9, (Sept 1968), p 112). (Loeb-Rutgers)
W70-02390

A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
Battelle-Northwest, Richland, Wash.
For primary bibliographic entry see Field 05B.
W70-02398

6B. Evaluation Process

REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
For primary bibliographic entry see Field 09D.
W70-02043

VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
Nevada Univ., Reno. Desert Research Inst.
P. A. Domenico.
Desert Res Inst Tech Rep Ser H-W, Publication No 3, Nev Univ, 1968. 46 p, 8 fig, 38 ref. OWRR Proj No A-014-NEV.

Descriptors: *Water resources development, *Water conservation, *Water demand, *Economic efficiency, *Value, Benefits, Costs, Water rights, Planning, Productivity, Cost analysis, Groundwater, Groundwater basins, Safe yield, Water values.
Identifiers: Water valuation, Groundwater management.

An attempt was made to analyze problems of groundwater management and development in terms of valuation of a resource or property that represents a source of future money receipts. An analytical expression is derived which gives both present worth of gains forthcoming from resource exploitation over a variable time period and the remaining worth of a groundwater supply after it has been partially depleted. With water-level position selected as the denominator common to both the system and its economic worth, a course of exploitation is charted so that (1) present worth of future returns is maximized, and (2) water rights are protected to the extent that water levels are not lowered below the economic limit of pumping. The results enable a conceptual valuation of (1) decision rules for efficiency in management, (2) optimal mining yield for specified conditions, and (3) the state of development of the resource at any time. (Knapp-USGS)
W70-02110

PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
California Univ., Santa Barbara.
Dean E. Mann.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 95, No IR3, p 375-384, Sept 1969. 10 p, 15 ref, append.

Descriptors: *Weather modification, *Policy matters, Public relations, Public opinion, Cloud seeding, Regulation, Insurance, Legislation, Legal aspects, Financing, Federal budgets, Bibliographies, State governments, Administration, Supervision, Damages, Control, Biological communities.
Identifiers: Public affairs, Regulations, International relations, Federal agencies.

Weather modification is a relatively new technique of environmental control promising important benefits but threatening significant disbenefits. As such, it is a proper subject for public regulation. Because experimentation and action programs are desirable, the imposition of controls should be carefully planned and phased to promote careful experimentation and protect ecological values. Public regulation is principally a state responsibility, but Federal involvement will be necessary and desirable. Federal and state governments must regulate to prevent contamination of projects and prevent projects from interfering with each other. Licensing and setting of scientific qualifications for researchers and practitioners are necessary, probably at state level. Projects of appropriate size must be undertaken to maximize scientific results while not endangering biological communities. Several Federal agencies are involved in weather modification; appropriate roles and missions must be assigned each. An appropriate administrative mechanism must be found for regulating weather modification. Serious questions of indemnification and international relations remain unanswered. (USBR)
W70-02129

COMPREHENSIVE PLANNING: IS IT SUFFICIENT,
Bureau of Reclamation, Denver, Colo.
B. P. Bellport, and H. P. Dugan.
Fourth Amer Water Resource Conf, Proc Ser No 6, Amer Water Resour Ass, p 175-183, 1969. 9 p, 3 ref.

Descriptors: *Planning, *Water Resources development, Policy matters, Project planning, Irrigation, Water resources, Foods, Economics, Water resources planning act, Ecology, Economic efficiency, Social values, Crops, Agriculture, Urbanization, Urban areas, Social needs.
Identifiers: Substitutes, Food supplies, Economic growth, Water resources management.

Comprehensive river basin planning being carried out under the Water Resources Planning Act of 1965 will provide a valuable test of our ability to meet the future requirements for food and fiber needed to maintain a prosperous Nation. Meeting these requirements does not represent the main goal of water resource development, but merely a minimum constraint. Other important social and economic goals may be identified under the overriding mandate to enhance the well-being of the people--regional growth, provision of economic opportunity, stabilization of communities, and provision of a satisfying human environment. Quantitative measures of these developmental or opportunity goals are needed in addition to present measures of economic efficiency. A comprehensive analysis of means to achieve these goals should recognize alternative water management schemes and alternative approaches such as transportation improvement, business stimulation, and provision of increased educational opportunities in economically lagging areas. Many urban problems are closely linked to rural problems. Efforts should be made to lessen the urbanization trends by developing the basic resources of water, land, and clear air in underpopulated regions. (USBR)
W70-02153

PLANNING WATER FOR 2000 A D,
Illinois State Water Survey, Urbana.
Sandor C. Csallany.
Fourth Amer Water Resource Conf, Proc Ser No 6, Amer Water Resource Ass, p 159-174, 1969. 16 p, 8 fig, 2 tab, 21 ref.

Descriptors: *Water consumption, *Water demand, *Planning, *Water supply, Watermanagement (Applied), Water requirements, Water Resources Planning Act, Water Resources Research Act, Water resources, Water resources development, Population growth, Forecasting, Legislation, Bibliographies.
Identifiers: *Water supply forecasting.

Federal legislation and studies on water resources planning for the U.S. are reviewed. The U.S. has enough water for maintaining economic growth over the next 32 yr and supporting an estimated population of 300 million in the year 2000. Water resources are not evenly distributed and severe shortages may develop in certain parts of the country. For proper planning and managing of water resources, available sources must be known and estimates made of future needs. Statistical studies of geographic areas and states show good correlation between population and water consumption. An empirical procedure is given for calculating water demand for the year 2000: first, population is projected for each state to the year 2000 and per capita water demand is estimated from the correlation between population and water consumption; second, the water demand is adjusted for increases caused by advances in technology and rising living standards. Recommendations for planning water resources for the year 2000 and beyond include using the simple estimating methods and launching a U.S. Water Resources Decade. The Decade should be governed by the U.S. Water Resources Committee, coordinating the activities of the many organizations on all phases of water resources planning. (USBR)
W70-02155

CONGRESS AND WATER RESOURCES,
Library of Congress, Washington, D.C.

For primary bibliographic entry see Field 06E.
W70-02160

THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
Imperial College of Science and Technology, London, (England).
For primary bibliographic entry see Field 08E.
W70-02162

EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES,
Battelle-Northwest, Richland, Wash.
Malcolm H. Karr.
Mater Res Stand, Vol 9, No 8, p 8-12, 63-64, Aug 1969. 7 p, 13 ref.

Descriptors: Land resources, Air pollution, *Natural resources, Water supply, Water resources, Water control, Resource conservation, Weather modification, Water quality, Irrigation, Fish and wildlife, Recreation, Navigation, *Resources, Management, Leadership, Stream pollution, Water law, *Resource development, Thermal pollution, Quality control, Flooding.
Identifiers: Air pollution control, Pollution control.

Wise resources management practices must be developed to overcome years of negligence. An interdisciplinary approach is required because of the complexity of resources management and the interrelationships among the different components. Suitable policy and understanding are lacking for effective management of environmental quality. The nature of institutional arrangements will control the effectiveness with which well-founded management recommendations can be implemented. Effective planning leadership at the state level is essential for ensuring the development of a dynamic public policy that can be successfully modified and updated as needed. (USBR)
W70-02168

A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
Office of Research and Statistics, Washington, D.C. Long-Range Research Branch.
Ronald F. Hoffman.
Public Finance, Vol 24, No 1, p 1-32, 1969. 32 p, 3 tab, 2 append.

Descriptors: *Local governments, *Welfare, Constraints, Maryland, Taxes.
Identifiers: *State aid, *Income redistribution, *Gross aid plan, *Net aid plan, *Redistributive rule, Need, Fiscal policy, Services, Capacity, Welfare maximization, Public education, Aid distribution.

This paper is primarily concerned with income redistribution aspects of state aid to local governments. The main purpose is to present a systematic way of looking at the aid problem and to indicate how the approach can yield a usable plan for the distribution of state aid to local governments. The paper is concerned with intercounty equalization of fiscal position. This notion refers to the relationship between the need for county services and the capacity or ability to meet that need. A straight-forward application of the constrained maximization of a welfare function is used to generate a redistributive rule. The rule is practical in several senses. It does not conflict with the ideas which apparently underlie the programs which are generally acceptable to policymakers and their constituents. Furthermore, the rule is stated in a form which makes the dollar aid shares to the counties directly computable. An example, including empirical estimates of the capacity and need variables, was presented using Maryland data for 1960. Such welfare maximization approaches used to generate decision rules might be applicable to the water area with respect to state aid programs for recreation and park projects that include water development. (Loeb-Rutgers)
W70-02269

PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
Virginia Polytechnic Inst., Blacksburg. Dept. of Sociology.
Charles A. Ibsen, and John A. Ballweg.
Available from the Clearinghouse as PB-188 501, $3.00 in paper copy, $0.65 in microfiche. Virginia Water Resources Research Center Bulletin 29, Sept 1969. 102 p, 62 tab, 1 append. OWRR Project A-029-VA.

Descriptors: *Attitudes, *Social aspects.
Identifiers: *Public perception.

The study dealt with the following research questions: (1) what are the factors related to public perception of water problems; (2) to what extent does the public view water as a problem and what is the basis of a problem perception; and (3) what action does the public feel should be taken toward a solution of perceived problems. A random sample of 500 was selected and these respondents were interviewed by telephone. The major findings related to public perception of water problems were: Three percent of the respondents volunteered a perception of water as a major problem facing the world today; Thirty-four percent of the respondents indicated they had considered water a problem; and The most common water problem verbalized by respondents was pollution. Correlates of a water problem perception were: Seventy-five percent of the respondents reported they had heard or read a discussion of some aspect of water problems; Television was reported as the source of information on water problems more often than any other communications media; The most common water problem reported by respondents as being discussed were water problems related to pollution. Public view of what should be done to solve water resource problems was: The majority of respondents who offered a solution to water problems felt that there was a need to enact more effective legislation; The majority of respondents felt that the private citizen and appropriate federal agencies were primarily responsible for initiation action to cope with water resource problems.
W70-02278

INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
Georgia Inst. of Tech., Atlanta.
C. Michael York.
Available from the Clearinghouse as PB-188 502, $3.00 in paper copy, $0.65 in microfiche. Water Resources Center, Georgia Institute of Technology WRC-0569, Sept 1969. 35 p, 11 tab, 19 ref, 6 append. OWRR Project B-024-GA.

Descriptors: *Attitudes, *Behavioral measurement, *Attitude measurement, *Psychological aspects, *Social behavior, *Social needs, *Social values, Social change, Social participation, Urban sociology, Decision-making, Correlation analysis, Public behavior, Political aspects, Political constraints.
Identifiers: Likert summation ratings, Thurstone equal-appearing-interval procedure.

The research objectives were: (1) to provide methodological demonstration of how attitude scaling can be accomplished in a problem-oriented context; (2) to provide an instrument suitable for use in the field as an information tool relating to a particular community water issue; and (3) to develop a better understanding of the phenomenon in question. Fluoridation of public water supplies was chosen as the issue for analysis because such an issue usually generates community conflict and an overt concern among elected officials, technical specialists and the public at large. Two traditional psychological scaling methods of attitude measurement were employed: The Likert summated ratings and the Thurstone equal-appearing-interval procedure. The end product sought was one or more instruments suitable for experimental investigation of a public policy question. An attempt at construct validation through an exploratory factor analysis of the intercorrelation matrix for the Likert items suggests that attitude toward fluoridation, the vehicle selected for the research analysis, encompasses more than 'fear of personal harm', 'violation of personal rights', and a 'public health innovation'. Measuring instruments, methods of scale construction and interpretation of the attitudes from the data collected are discussed and illustrated. These instruments and methodology are recommended to decision-makers and officials for application in the conservation, development, management, and use of water resources. The results of the studies suggest further research into issues which involve deep commitment. (Conway-Georgia Tech)
W70-02279

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
Water Resources Engineers, Inc., Walnut Creek, Calif.; and Washington Univ., Seattle.
For primary bibliographic entry see Field 05G.
W70-02311

ECONOMICS OF WATERSHED PLANNING.

Edited by Tolley, G S and Riggs, F E. Ames, Iowa, The Iowa State University Press, 1961. 339 p.

Descriptors: *Watershed management, *Economics, *Watersheds, *Water resources, Engineering, Planning, Resource development, Benefits, Investment, River basin development, Geology, Income, Mathematical studies, Cost sharing, Costs, Legal aspects, Conservation, Constraints, Dams, Flood control, Flood damage, Groundwater, Interest, Irrigation, Land use, Management, Recreation, Return, Wildlife.
Identifiers: *Watershed planning, Watershed development, Engineering data, Programming, Quantitative application, Public interest, Property rights, Eastern States, Flood prevention, Geography.

The increased interest in the problems of water resources in this country suggests that the desirability of advance planning is being recognized. Programs now under way are helping to accumulate experience that will be ever more valuable as water problems increase in importance. Watersheds are being developed throughout the country by building small dams, clearing stream channels, adjusting cropping patterns to control water runoff and improve incomes, and by making other investments in a small-area context. While this book is concerned partly with how small watershed development can best fit into river basin and regional planning, its more general aim is to contribute to a variety of working-level planning decisions that concern technicians, administrators, and legislators in ongoing water resources development. This volume contains the proceedings of a Symposium on the Economics of Watershed Planning held in Knoxville, Tennessee, in June 1959. The papers look at the economic, organizational and legal problems encountered in watershed planning. (See also W70-02375 thru W70-02383). (Loeb-Rutgers)
W70-02374

COMMENT ON 'WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT',
Wisconsin Univ., Madison.
Raymond J. Penn.
In: Economics of Watershed Planning, p 24-26, Iowa State University Press, Ames, 1961. 3 p.

Descriptors: *Resource development, Wisconsin, Water utilization, Flood control.
Identifiers: *Watershed development, Watershed programs, Economic development, Resource management.

The author contends that, in concentrating on what we do with water, we have overlooked much of the real significance of watershed programs. A watershed program exists to permit a variety of economic groups to work together. Water is the

critical resource and initially the main focus of attention, but inevitably a watershed organization finds itself considering other resources and all kinds of questions of community and economic development. For these reasons the author emphasizes the possibilities of the watershed organization as an action and planning unit for economic development as well as resource management. Water allocation is becoming increasingly involved in intergroup conflicts. There are problems of how to protect the public interest, how to maintain sufficient security of water supplies to warrant individual investment, etc. Wisconsin, as in most eastern states, has only recently become aware of major water allocation problems. New water use problems are developing that the old rules don't govern well. Procedures are needed for balancing the interests of water users in view of the availability of water. Watershed organizations are already involved in flood control. The author suggests that they give attention to other surface water problems and underground water as well. (See W70-02374). (Loeb-Rutgers)
W70-02375

WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT,
Soil Conservation Service, Washington, D.C.
Gladwin E. Young.
In: Economics of Watershed Planning, p 15-24, Iowa State University Press, Ames, 1961. 10 p.

Descriptors: Watershed management, Resource development, Watersheds, Cost-benefit analysis, Land development, Water resources development, Governments, Conservation, River basins, Planning.
Identifiers: *Watershed development, Concentration, Research, Data, Engineering standards.

Up to this time relatively little of the total land and water resource development has been done by government. The most important function of government in the resource field is conservation. Through conservation programs, public assistance is made available for acceptance on a voluntary basis to those who use our land and water resources. The author contends that a policy by this country to direct its efforts toward public resource development projects to the exclusion of resource conservation programs is not a defensible policy. At the same time, the opportunities for resource development through public works projects carried out by the Federal Government should not be overlooked. The author continues with a discussion on watershed planning in relation to river basin planning, the objectives of watershed development, the extent of watershed development, regional concentrations of watershed projects, the kinds of problems attacked by watershed programs, and a discussion on watershed research. All of these have important economic ramifications of which the water researcher in this area should be aware. (See W70-02374). (Loeb-Rutgers)
W70-02376

INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
Soil Conservation Service, Spartanburg, S.C.
Eugene C. Buie, Ernest F. Carmichael, and John E. McLean.
In: Economics of Watershed Planning, p 87-95, Iowa State University Press, Ames, 1961. 9 p.

Descriptors: Watershed management, Economics, Geology, Engineering, Soil science, Technology.
Identifiers: *Interdisciplinary teamwork, *Watershed planning, Plant technology, Flood prevention.

Watershed project planning in the Soil Conservation Service is a coordinated analysis by a team of technicians representing various disciplines. The principle disciplines are economics, hydrology, geology, engineering, general soil science, and plant technology. There is no defined line between the areas of responsibility of each of these; each is dependent upon and interrelated with the others. Formulating a watershed plan requires that the technicians select an economically feasible system of improvements compatible with the economic and social conditions of the watershed. This paper reviews the planning process, emphasizing requirements for successful teamwork. Interdisciplinary teamwork has become almost essential in certain areas of water research due to the fact that water problems often impinge upon several areas of expertise. (See W70-02374). (Loeb-Rutgers)
W70-02377

THE STATE OF ECONOMIC DATA,
Department of Agriculture, Raleigh, N.C.
C. V. Lyle.
In: Economics of Watershed Planning, p 111-120, Iowa State University Press, Ames, 1961. 10 p.

Descriptors: Economics, Watersheds, Prices, Costs, Land use, Water use, Interest rate, Flood damage, Benefits.
Identifiers: *Economic data, Watershed planning.

The author suggests that the truism that the strength of a chain is determined by its weakest link may well be illustrated in watershed planning. The results of planning evolve from a series of interrelated statistical determinations and the dependability of conclusions rests on the accuracy of each. There are also shortcomings in the theory, philosophy, and policy of watershed planning. This paper points out that the needs for better economic data are pressing. For certain deficiencies, needs are so obvious that at times lack of improvement appears ludicrous to the planner forced to use the data available. There are also less obvious needed improvements involving more difficult relationships--those concerned with relatively complex economic principles, frequently based largely upon opinions and assumptions. The author suggests the creation of a group with the responsibility for basic data of all types needed in the study, formulation, and development of land and water resource programs. (See W70-02374). (Loeb-Rutgers)
W70-02378

MATHEMATICAL ANALYSIS: MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
Iowa State Univ., Ames.
Earl O. Heady.
In: Economics of Watershed Planning, p 197-216, Iowa State University Press, Ames, 1961. 20 p.

Descriptors: *Mathematical models, Investment, Welfare, Demand, Costs, Watersheds.
Identifiers: *Mathematical analysis, *Watershed planning, Restraints, Funds, Production function.

This paper presents a model for specifying the optimum scale of investment and the optimum allocation of a given investment between alternatives within a watershed. Suggestions are included on how data might be incorporated in the model and computations made to provide solutions. A complete mathematical formulation of an appropriate welfare economics model would entail specification of utility functions for individuals; demand, production, and cost functions for products both within and outside the watershed; and the calculus under which social welfare is maximized. However, this model has no current prospect for empirical application. Some of the quantities, particularly those relating to utility functions, have no promise of measurement. We must turn to some programming models of 'small watersheds in isolation' as representative of mathematical approaches which are operational in view of data availability. Even these can become extremely complex if they recognize the relevant inter-year relationships connecting activities of the system over time, the resulting 'intermediate products,' the necessary maximum and minimum restraints, the process of capital growth, the appropriate planning horizon or period and demand functions other than those representative of pure competition. (See W70-02374). (Loeb-Rutgers)
W70-02380

COMMENT ON 'PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY',
Tennessee Valley Authority, Knoxville.
Emanual L. Baum, and Leland G. Allbaugh.
In: Economics of Watershed Planning, p 13-14, Iowa State University Press, Ames, 1961. 2 p.

Descriptors: *Watersheds, Watershed management, Institutions, Cost-benefit analysis, Linear programming, Operations research, River basins, Planning.
Identifiers: Watershed development, Quantitative technique.

The authors agree with Wantrup in that certain objectives of watershed development are not expressed adequately through the market mechanism. They further agree that more thought should be given to changes in institutions to help achieve the objectives of watershed programs. However, they suggest that the value considerations that underlie existing institutions need to be critically evaluated before progress can be made in altering these institutions. While the social scientist should not try to impose values on the community, he can provide information so that policy-makers are better able to formulate their goals. While agreeing with Wantrup that the watershed is unique largely as a producing unit, the authors point out that as producing unit per se, it requires no procedures not applicable to other resources and producing units. Hence, a more positive approach might systematically examine the extent to which research procedures connected with resource use in other areas can be applied to watersheds. While Wantrup favors benefit-cost analysis, he lacks enthusiasm for other quantitative techniques. This de-emphasis of other quantitative approaches is found unacceptable by Baum and Allbaugh. Unlike Wantrup, the authors feel that there should be a distinction between river basin and small watershed programs. (See W70-02374). (Loeb-Rutgers)
W70-02381

PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
California Univ., Berkeley.
S. V. Ciriacy-Wantrup.
In: Economics of Watershed Planning, p 1-12, Iowa State University Press, Ames, 1961. 12 p.

Descriptors: *Watershed management, Technology, Watersheds, Prices, Economics, Economies of scale, Diseconomies of scale, Cost-benefit analysis, Constraints, Welfare.
Identifiers: *Philosophy, *Watershed policy, Policy-making, Technological change, Social sciences, Watershed projects, Objectives, Criteria, Price system.

The author proposes to focus on some of the essential concepts and principles that underlie the economics of watershed development and that need to be considered in public policy. As a proposition, one may submit that the watershed has emerged rather recently in the social sciences as a unit of understanding and policy-making. This emergence appears connected with technological change and with shifting demands for the main products of a watershed in the course of economic development. Water-quality management becomes increasingly important as the demand for products of watersheds increases. Two conclusions can be drawn from this sketch of the emergence of the watershed as a concept in the social sciences. First, the physical and economic interrelations that make the watershed a unit in the social sciences operate largely on the side of production and not on the side of consumption. Second, that a watershed as a helpful conceptual unit in the social sciences is not immutable. It is a concept of economic dynamics and not of statics. The author continues his discussion by showing the difference between the

economics of watershed policy and the economics of watershed projects. This includes a discussion pertaining to the objectives and criteria of watershed policy as well as one on benefit-cost analysis and watershed policy. (See W70-02374). (Loeb-Rutgers)
W70-02382

EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
Norwegian School of Economics and Business Administration, Bergen.
Karl Borch.
Journal of Financial and Quantitative Analysis, Vol IV, No 1, p 1-14, Mar 1969. 15 p, 6 ref.

Descriptors: *Capital, *Financing, Risks, Profit, Optimization, Value, Interest rate, Prices, Economic analysis, Government, Capital supply.
Identifiers: *Invisible hand, *Bonds, *Shares, Loans, Prejudices, Capital markets.

The author wishes to show that with the introduction of uncertainty, decentralized decision making is likely to lead to a suboptimal situation. Collective action is shown to be the way in which rational people will reach an optimal situation. This requires that some of the classical assumptions about economic behavior be abandoned. To demonstrate this condition, the author discusses the problem of selecting the best investment from some set of available investments. The problem of the entrepreneur in obtaining capital either by issuing bonds or selling shares is studied and it is found that the market determines the conditions of the arrangement. The author also studies the way in which two persons will bargain in the absence of a market, and the ramifications for optimal distribution. Although it does not discuss water resource planning directly, the importance of the operation of the capital market and market mechanisms in the water resource area make this article relevant to water researchers. (Murphy-Rutgers)
W70-02384

WATERWAY INDUSTRIAL SITES: A CHICAGO CASE STUDY,
David M. Solzman.
Chicago, Illinois, University of Chicago Press, 1966. 141 p.

Descriptors: *Channels, *Sites, Illinois, Transportation.
Identifiers: *Chicago, Urban space, Michigan Canal, Industrial development, Waterfront industries, Waterway resources, Waterway land, Locational stability, Technological change, Recreational uses.

The present study traces the development of a surface waterway intended to generate new opportunites and connections for the Chicago region. Technological improvements in other modes of transportation led to a decline in the importance of this once premier resource. The author investigates the extent to which waterfront sites attract industry and whether inland waterways in central urban areas play an important role in creating increased locational stability for industries sited along the banks. It is shown that industrial growth and decline observed along the waterway is approximately the same order of magnitude as that experienced elsewhere within the city at comparable distances from the center. Where locational stability of industries along the waterway exceeds the mean index for the same distance from the city center, the increased stability or growth is shown to be related to factors other than the presence of the waterway. The author suggests that if industries continue to migrate to the periphery of urban areas, the best development for close-in riverfront lands may well be for parks and recreational uses (Loeb-Rutgers)
W70-02386

RIVER BASIN ADMINISTRATION AND THE DELAWARE,
For primary bibliographic entry see Field 06E.
W70-02387

A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
Idaho Univ., Moscow.
John R. McKean.
Journal of Financial and Quantitative Analysis Vol IV, No 1, p 15-24, Mar 1969. 10 p, 1 tab, 6 ref.

Descriptors: *Prices, *Government, Economic analysis, Industrial production, Public utilities, Resource development, Cost-benefit analysis, Demand, Marginal cost, Average costs, Economics, Total cost, Monopoly, Mathematical studies, Regulation.
Identifiers: *Price stability, *Demand variability, Cost functions, Rate of return, Inventory, Regulated industries.

This article examines the price and cost behavior of non-competitive industries. The author claims the static micro theory approach to predicting average cost on the basis of expected output is unrealistic. The total distribution of expected output over the period will influence the average costs of production. Thus, predictions of average cost from secular data should take account of all relevant moments of the distribution of output. The author shows that firms may have incentive to influence the variability of demand. It is shown that if marginal cost is rising, stabilizing demand will reduce average costs. The author gives a brief explanation of how this may effect six applied pricing areas. One of the effected areas is the analysis of regulated industry, public utilities and resource development proposals. Benefit-costs or rate of return estimates may be improved by accounting for output variability in the determination of price. Thus, this article has ramifications in the water resource area. (Murphy-Rutgers)
W70-02388

PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION: SOME ANALYSIS AND TESTING,
Ryuzo Sato, and Ronald F. Hoffman.
The Review of Economics and Statistics Vol L, No 4, p 453-460, Nov 1968. 8 p, 14 ref.

Descriptors: *Capital, *Labor, *Industrial production, Economics, Mathematical studies, Technology, Wages, Cost allocation, Diseconomies of scale, Economies of scale, Costs.
Identifiers: *Production function, *CES, *VES, Capital intensity, Factor share, Marginal rate of substitution, Output.

An index of important properties of a production function is its elasticity of factor substitution function. With variable elasticity of factor substitution (VES), the production function depends on the assumptions involved in the elasticity of factor substitution function. This paper tries to show the extent to which one can generalize beyond the assumption of a constant elasticity of substitution (CES) and still derive an explicit form of the production function. Two different approaches to explicit VES production functions are discussed. The first relates the elasticity of factor substitution to capital intensity. The second approach considers the elasticity of factor substitution as a linear function of time. The potential use of production function analysis in water resource planning makes this article relevant for the water resource planner. (Murphy-Rutgers)
W70-02389

WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
Illinois Univ., Urbana. Water Resources Center.
For primary bibliographic entry see Field 06C.
W70-02391

THE LAST FRONTIER: AMERICA'S ARID PUBLIC LANDS,
Bureau of Land Management, Washington, D.C.
Eugene V. Zumwalt.
Arizona Review, Vol 18, No 12, p 1-5, Dec 1969.

Descriptors: *Arid lands, *Public lands, *Land classification, *Reclamation, *Multiple purpose project, Land management, Semiarid climates, Irrigation programs, Ranges, Range management, Decision making, Land resources, Mineral industry, Planning, Water resources, Ecology, Grazing, Water conservation, Watershed management.
Identifiers: *Western U.S.

The most common factor of the vast area of public lands of the U.S., stretching from Southern Arizona to the Arctic Ocean, is aridity. Until the 1930's use of these lands was a trial and error attempt to adapt institutions and laws of a humid land to an arid land. It did not work. Successful land reclamation for large irrigation projects required vast sums of money and technical know-how generally available only at the federal level. Uncontrolled use of non-irrigated lands for mineral exploration and exploitation and for grazing put such pressure on the fine ecological balance of the arid lands that they began to deteriorate. Where water was available for irrigation, Federal reclamation programs were developed on a long term planning basis. In 1934 the Taylor Act placed the remaining lands, where only limited moisture of an arid climate was available, under federal controls which closed it to all but carefully planned and managed use. The author reviews development of land classification schemes and programs for land-use decisions - hopefully based on knowledge of their consequences. He emphasizes that our arid lands are our last frontier. There is no place else to move in the U.S. if we make mistakes. If the arid lands are mismanaged they could become an ecological disaster. (Crouse-Arizona)
W70-02420

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

THE INVESTMENT DECISION FOR SEEPAGE REDUCTION,
Arizona Agricultural Experiment Station, Tucson.
Robert A. Young.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 139-143, Apr 1969. 5 p, 8 ref.

Descriptors: *Seepage, *Economic efficiency, Investment, Cost-benefit analysis.

Seepage-reduction investments appear to present no special conceptual problem. Therefore, concentrate should center on reviewing general investment principles, emphasizing that decisions which effectively represent the client's interest (whether the client is a private individual or the general public) should be based on the selection of appropriate choice criteria and models, should be based on consideration of only those cost and benefit items incremental to the decision, and should be based on appropriate valuation procedures and discount rates.
W70-02156

ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
Water Research Association, Medmenham (England).
For primary bibliographic entry see Field 06A.
W70-02256

REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
Camp, Dresser and McKee, Boston, Mass.
For primary bibliographic entry see Field 05G.
W70-02258

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 06A.
W70-02264

WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
Illinois Univ., Urbana. Water Resources Center.
Hamdy H. H. Afifi, and V. Lewis Bassie.
Available from Univ of Illinois, Bureau of Economic and Business Research, Urbana, Ill, 61801, for $3.00 per copy. University of Illinois Bulletin Number 83, 1969. 153 p, 41 tab, 16 charts. OWRR Project A-008-ILL.

Descriptors: *Prices, *Economics, Illinois, Marketing, *Water rates, Costs, Rates, Use rates, Scheduling.

The economics of water supply is reviewed and the water industry in Illinois is analyzed. Rate schedules in use in Illinois are described and analyzed. Various pricing bases are discussed with comments on their frequency of use or consideration in Illinois. Eight recommendations are presented for consideration in water pricing: (1) rate schedules should be regularly reviewed and revised; (2) cost data should be compiled and analyzed annually; (3) facilities, rates and operating procedures should be adjusted to minimize water waste; (4) political considerations should be excluded from problems of operation and expansion of publicly owned systems; (5) regulatory agencies should make better use of statistics in appraising industry conditions; (6) planning of future operations should be undertaken; (7) regional federations of water systems should be considered; and (8) federal and state agencies should promote planning on a basin-wide basis.
W70-02391

6D. Water Demand

PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
Geological Survey, Jacksonville, Fla.
For primary bibliographic entry see Field 03D.
W70-02092

INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
Bureau of the Budget, Washington, D.C.
K. William Easter.
Fourth Amer Water Resour Conf, Proc Ser No 6, Amer Water Resour Ass, p 191-200, 1969. 10 p, 2 tab, 12 ref.

Descriptors: *Inter-basin transfers, *Water resources, Economics, Economic feasibility, Benefits, Costs, Agriculture, Irrigation water, Analysis, Water costs, Water policy, Municipal water, Industrial water, Water reuse, Water consumption, Water conveyance.
Identifiers: *Interbasin water transfer, Waste water reclamation.

Transfer of water between river basins is not new. California, Colorado, and New York have completed water transfers between basins. These transfers are small in comparison to proposals for diverting 2.4 to 30 million acre-ft of Columbia River water into the Colorado River or for diverting 16.5 million acre-ft from the lower Mississippi River to west Texas and eastern New Mexico. Such large interbasin transfers involve large investments that will be long-lived and have irreversible effects on environment. The long life of structures leads to inflexibility in water systems for incorporating technological innovations. These characteristics helpillustrate the special need for complete analysis of proposed water transfers. Some important economic issues and impacts that should be analyzed are discussed. Large, western interbasin water transfers have a potential for creating and solving economic problems. Until extensive studies are completed, the national economic value and cost of proposed water transfers are difficult to judge. These water transfers are just another possible alternative water source for certain sections of the United States needing further evaluation. (USBR)
W70-02152

ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
Bureau of Reclamation, Washington, D.C.
For primary bibliographic entry see Field 03E.
W70-02167

AN ECONOMETRIC MODEL FOR PREDICTING WATER-ORIENTED OUTDOOR RECREATION DEMAND,
Economic Research Service, Washington, D.C. Natural Resource Economics Div.; and Missouri Agricultural Experiment Station, Columbia.
Gleen A. Gillespie, and Durward Brewer.
US Department of Agriculture, Economic Research Service, ERS-402, p 1-15, Mar 1969. 15 p, 5 ref, 1 append.

Descriptors: *Recreation demand, Recreation facilities, Social participation, Water demand, Water utilization.

Land-use planners and investors can now make better estimates of the demand for water-oriented recreation facilities in specific areas. The estimates are made by using an econometric model developed in cooperative USDA-State research. The model, one of the first of its kind, analyzes socioeconomic characteristics associated with water-oriented outdoor recreation activities of people: annual family income, education, sex, race, age, and occupation. The model, applied to a 1,000-family sample of people in the St. Louis, Mo., area indicated that they would have averaged 27.3 days of water-oriented recreation a year. Interviews revealed that the families spent 27.0 days showing how closely the estimate followed the known data. Future demand can be estimated, with acceptable accuracy, through use of the model with data from census reports, much in the same way as the test was done. If certain socioeconomic characteristics of the population are expected to change over time, allowances can be made to estimate resulting changes in recreation demand. As a family moves up the income scale, a corresponding increase in recreation activity is expected. As education levels increase, recreation demand will increase. Because the methodology is based on a sample survey of only one metropolitan population in one time period, the appropriateness of using the model in other metropolitan areas must be carefully assessed. Other areas may have radically different characteristics, especially the available supply of outdoor recreation facilities. The coefficients (socioeconomic characteristics) should also be reassessed for changes which may occur overtime.
W70-02194

TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
Stanford Research Inst., Menlo Park, Calif.
Russell F. Scarato.
Water Resources Res, Vol 5, No 5, p 929-936, Oct 1969. 8 p, 4 fig, 8 ref.

Descriptors: *Cost-benefit analysis, *Water demand, *Economies of scale, *Systems analysis, Design criteria, Decision making, Municipal water, Water distribution (Applied).

A capacity expansion model was employed to determine when and how much excess capacity should have been installed to meet increasing, exogenously determined demands at a minimum cost. The study analyzed the economic impact both of the economies of scale in construction and of the real cost of capital. The economic effects of timing and sizing decisions on total costs were plotted for various, interest rates and levels of economies of scale. The study demonstrated that the costs of expansion were sensitive to the increase in demand specific to the facility of being planned and that the design capacity must be set individually for each separable water system component according to its particular cost function. These findings suggested that the standard practice of designing excess capacity in a water system to meet a fixed future demand (i.e., 25 year system) should be revised. (Thiuri-Cornell)
W70-02267

ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
Purdue Univ., Lafayette, Ind. Dept. of Geosciences.
For primary bibliographic entry see Field 02F.
W70-02288

6E. Water Law and Institutions

CONTAMINATION OF DRINKING WATER.
For primary bibliographic entry see Field 05G.
W70-02049

CITIZENS COMMITTEE FOR THE HUDSON VALLEY V VOLPE (CONSTRUCTION PERMITS WITHOUT APPROVAL AS REQUIRED BY THE RIVERS AND HARBORS ACT OF 1899).

302 F Supp 1083-1094 (SD NY 1969).

Descriptors: *Federal jurisdiction, *Navigable waters, *Road construction, *Rivers and Harbors Act, Regulation, Highways, Highway relocation, Embankments, Obstruction to flow, Navigation, Permits, Administrative agencies, Legal aspects, Judicial decisions, Dikes, Check structures, Natural resources, Hudson River, Bridges, Conservation.

Plaintiffs challenged the construction of the proposed Hudson River Expressway. They claimed that since the expressway project involved construction of dikes, causeways, and bridges over or in a navigable waterway of the United States, the Corps of Engineers exceeded its authority in issuing construction permits without approval of Congress or the Department of Transportation as required in the River and Harbors Act of 1899. The Court held that the defendant Corps had approved construction of dikes without requisite Congressional approval and had thus exceeded its authority. The Court stated that the term 'dike' should be used in its ordinary sense and that a dike did not necessarily have to affect the navigability of a stream to be defined as such. The court further found that a permit to construct causeways had similarly been issued ultra vires by the Corps. A primary function delegated to the Department of Transportation is conservation of natural resources; permitting state or private concerns to construct causeways without prior approval would tend to frustrate performance of that function. (Kelly-Florida)
W70-02061

WATER QUALITY STANDARDS SUMMARY.
Federal Water Pollution Control Administration, Helena, Mont.
For primary bibliographic entry see Field 05G.
W70-02069

CANALS AND POOLS.

Pa Stat Ann Tit 55, Secs 801-803, 809, 822, 823, 824 (Supp 1969).

Descriptors: *Pennsylvania, *Canals, *Artificial watercourses, *Navigation, Conveyance structures, Legislation, Transportation, Boats, Inland waterways, Canal construction, Berms, Administrative agencies, Highways, Embankments, Banks, Docks, Regulation, Boating regulations, Diversion, Maintenance, Industrial water, Domestic water, Water utilization.
Identifiers: *Obstructions to navigation.

It is unlawful to lead or drive any animal upon the towing path of any canal or pool except for the purpose of towing boats upon the waters of such artificial navigation. It is unlawful for any boat, craft, or floatable thing to be so moored or placed in any such canal as to obstruct the use thereof. Willful obstruction of navigation by any means is punishable by a fifty dollar fine. Any property abandoned on the banks or waters of such canals may be seized and sold at auction by canal officers. The Canal Commissioners may authorize the construction and use of wharves by landowners adjoining such canals so long as the wharves do not interfere with free navigation. Purchasers of state canals must keep the canals in a condition of repair and fitness for use equal to that at the time of purchase. Any person vested with the franchise of constructing, maintaining, and using a canal may convert the waters therein to domestic manufacturing and commercial uses. (Schram-Florida)
W70-02127

CONTROL AND DRAINAGE OF WATER FROM COAL MINES.

Pa Stat Ann Tit 52, Secs 682-683 (1966).

Descriptors: *Pennsylvania, *Mine water, *Mine drainage, *Coal mines, Legislation, Mining engineering, Safety, Flood control, Backfill, Hydraulic mine-filling, Public health, Landfills, Ditches, Flumes, Hydraulic mining water, Administrative agencies, Streambeds, Stream improvement, Pumping, Pumps, Federal project policy, Financing.

In the event that federal money is made available on a matching basis for the control and drainage of water from coal formations, to seal abandoned coal mines, and to fill voids in abandoned mines, the state accepts the aid subject to the terms and conditions of the grant. In such event, the Department of Mines and Mineral Industries shall construct ditches, flumes, backfill stripping pits and cropfalls, and improve stream beds for the purpose of preventing the flow of water into mines. They shall also purchase the necessary materials to pump water from abandoned mines, and to seal and fill voids in abandoned coal mines. The state, however, shall not bear any operating or maintenance costs other than one-half of the power pumping costs except in cases of emergencies. When an emergency exists, the Department shall: (1) conduct rescue operations; (2) purchase equipment and provide labor for pumping water or other necessary work to reduce the hazards from flooding; (3) pay for power and other costs for mine drainage; and (4) conduct investigations to determine the cause of the disaster and to institute measures to insure the future safety and health of persons in the area. (Schram-Florida)
W70-02128

INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
R I Gen Laws Ann Secs 46-17-1 (1956), 46-17-2 thru 46-17-5 (Supp 1968).

Descriptors: *Rhode Island, *Interstate compacts, *Water resources development, *Administrative agencies, Legislation, Legal aspects, Interstate commissions, Interstate rivers, Water policy, Water resources, Optimum development plans, Conjunctive use, Water management (Applied), Water rights, Administration, Planning, Investigations.
Identifiers: *Northeastern Resources Commission.

The governor is authorized to enter into an interstate compact for protection of the water resources of Rhode Island originating outside of that state and for protection of water resources of other states originating within Rhode Island. The northeast part of the United States requires coordinated planning for effective water resource management; the purpose of the compact is to provide an organization for cooperation in planning and coordinating policies and programs in the field of water and related land resources. The Northeastern Resources Commission by virtue of the compact will be responsible for coordinating, planning, investigating, and programming water and related land resources development. Nothing in this compact is deemed to impair or supersede the authority or jurisdiction of an existing interstate agency or agreement. The Rhode Island legislature has approved the compact and hereby grants the state's representatives all powers necessary and incidental to carry out the proper purposes of the Commission. (Kelly-Florida)
W70-02135

SEVERANCE STUDIES,
James H. Boykin.
Right Way, Vol 16, No 4, p 16-21, Aug 1969. 6 p.

Descriptors: *Severance, *Right-of-way, Appraisals, Project planning, *Land appraisal, Surveys, Legal aspects, Economics, Real property, Unit costs, Value, Analysis, Highways.
Identifiers: *Land acquisition, Highway engineering, *Partial taking.

An analysis was undertaken to find ways of modifying state highway right-of-way severance studies (land economic studies) to provide independent fee appraisers with valuable and much-needed appraisal data. The findings would probably improve the accuracy and reliability of remainder parcel appraisals, leading to increased effectiveness of appraisers' court testimony as expert witnesses. Severance study data are generally very complete; less than half the highway department studies contain adjustments for nonright-of-way influences on value. State personnel conducting the studies are considered to be well trained. Over half the studies are designed to assist appraisers in estimating the values of remainder parcels. Less than 20% of the reports are intended for use as outright comparable remainder sales, but independent appraisers use them almost as often as sales data as for value lost (or gained) severance studies. Studies are readily available from highway departments. Severance studies generally have not been allowed in court; over half the studies allowed are restricted to being used as comparable sales. (USBR)
W70-02147

BOUNDARIES, JURISDICTION AND EMBLEMS.

Va Code Ann secs 7.1-14, 7.1-17, 7.1-20 (1966).

Descriptors: *Virginia, *Lighthouses, *Federal jurisdiction, *State jurisdiction, Easements, Condemnation, Right-of-way, Marshes, Coastal marshes, Channels, Canal construction, Navigation, Leases, Taxes, Regulation, Harbors, Boundaries, Eminent domain, Construction, Natural resources, Forests, Agriculture, Navigable waters, Rivers.

The Governor has the authority to convey or lease to the United States any land belonging to the state for the site of a lighthouse, beacon, lifesaving station, or other aid to navigation. Title to such land reverts to the state unless construction is begun within two years and completed within ten years or if its use is discontinued for five years. Although jurisdiction over such land is ceded to the Federal Government, Virginia reserves certain express rights therein. The conditional consent of Virginia is given to the United States to acquire land by eminent domain in Virginia for: (1) the conservation of forest or natural resources; (2) the retirement of submarginal agricultural lands from cultivation and utilization; (3) the improvement of rivers and harbors; and (4) any other purpose of the United States. The Governor may convey certain marshes to the United States for canal or channel construction. He may also convey certain vacant, waste, and unappropriated lands to the United States. (Schram-Florida)
W70-02150

CONGRESS AND WATER RESOURCES,
Library of Congress, Washington, D.C.
Theodore M. Schad.
Fourth Amer Water Resource Conf, Proc Ser No 6, Amer Water Resource Ass, p 680-691, (1969). 12 p, 1 tab, 6 ref.

Descriptors: *Water resources, *Federal government, *Legislation, *Policy matters, Legal aspects, Committees, Planning, Projects.
Identifiers: Bureau of Reclamation, Corps of Engineers, Federal agencies, *United States Congress.

The pervasive nature of water resources and effects on all aspects of the national economy are shown in an analysis of Congressional handling of related legislation. In the 89th Congress, 1279 legislative measures (more than 5% of the bills and joint resolutions introduced) were concerned with water resources. Under the rules of the U.S. Senate and House of Representatives governing referral of bills, the water resources measures were referred to 11 committees in the Senate and 13 in the House. As a result, opportunities exist for promulgation of inconsistent policies for similar programs emanating from different committees. One recent tendency has been for committees to recommend legislation cutting across jurisdictional lines to provide uniform policies applicable to all Federal programs. Nevertheless, many problems of divided responsibility for water resources in the Executive branch are linked to the organization of Congress for dealing with water resources. (USBR)
W70-02160

ABANDONED MINES.
For primary bibliographic entry see Field 05G.
W70-02163

SHELLFISH GROUNDS AND PACKING HOUSES.

R I Gen Laws Ann secs 21-14-1 thru 21-14-9, 21-14-11, 21-14-14, 21-14-15 (1968).

Descriptors: *Rhode Island, *Commercial shellfish, *Water pollution, *Public health, Shellfish, Aquatic animals, Commercial fish, Commercial fishing, Aquatic life, Aquatic environment, Permits, Fish management, Administration, Administrative agencies, Regulation, Standards, Sewage, Dredging, Legislation, Environmental sanitation, Condemnation, Water quality, Fishkill.

A license is required for the operation of any shellfish business. The Director of the State Department of Health is charged with: investigating license applicants for compliance with the provisions of this chapter; adopting regulations requiring sanitation in the shellfish business; and investigating the sanitary condition of the waters overlying shellfish grounds. Waters found to be unsatisfactory are declared polluted. The Director is to consider the volume and dilution of sewerage, bacteria, and distance from polluted areas in making such declarations. No person shall take shellfish from polluted areas except for transplanting such shellfish by permit. No person shall work a dredge, pair of tongs, or rake while in a polluted area. No person shall sell or possess any shellfish taken from a poluted area. The Director shall adopt regulations and enforce the provisions of this act. Appointed enforcement agents may arrest persons or seize shellfish, boats or implements when violations of this chapter are discovered. Penalties for violations are enumerated. (Smith-Florida)
W70-02268

INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
Georgia Inst. of Tech., Atlanta.
For primary bibliographic entry see Field 06B.
W70-02279

RIVER BASIN ADMINISTRATION AND THE DELAWARE,
Roscoe C. Martin, Guthrie S. Birkhead, and Jesse Burkhead.
Syracuse, New York, Syracuse University Press, 1960. 390 p.

Descriptors: *Delaware River, *Financial feasibility, *Financing, *River basins, River basin development, Water resources development, Governments, Economics, Legal aspects, Organizations, Financial analysis, Water resources, Industrial water, Water demand, Water management, Administration, Water quality, Water pollution, Planning, Irrigation, Recreation, Flood control, Watershed management.
Identifiers: *River basin administration, Basin agency, Basin development, Regional action, Intrastate basin development, Interstate basin development, Delaware River Basin, Water quantity.

This study develops the position that the most appropriate organization for the administration of the Delaware River's water resources in their larger setting is a Basin-wide agency with jurisdiction over water and water-related activities. The new agency will not supersede the traditional units of government, but on the contrary will build on and strengthen existing national, state, and local agencies and programs. Its chief responsibility will be to introduce an overview of Basin water problems, to plan a comprehensive water program, and by complementary action to assist in effectuating the Basin plan. Its principal influence on existing governments may be expected to result from persuasion and example, and from the introduction of positive thinking through assertion of leadership. It is the purpose of this study by making a systematic examination of the problems of river basin administration to provide background for effective action in the increasingly complex field of water-resource management. (Loeb-Rutgers)
W70-02387

6F. Nonstructural Alternatives

FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-02121

FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-02122

FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-02123

6G. Ecologic Impact of Water Development

ECOLOGICAL EFFECTS OF WEATHER MODIFICATION: A PROBLEM ANALYSIS,
Michigan Univ., Ann Arbor. Dept. of Resource Planning and Conservation.
Charles F. Cooper, and William C. Jolly.
Mich Univ School Natur Resources Rep, May 1969. 160 p, 140 ref. Contract 14-06-D-6576, (Bur of Reclam, Office of Atmos Water Resources, Denver, Colo.)

Descriptors: *Weather modification, *Cloud seeding, *Environmental effects, Vegetation effects, Biology, Diseases, Ecology, Growth rates, Habitats, Insect resistance, Water pollution, Insecticides.
Identifiers: Weather modification effects.

The ecological effects of weather modification are discussed and the existing literature on the subject is surveyed. If deliberate modification of weather can be achieved, the structure of plant and animal communities will be altered through shifts in rates of reproduction, growth, and mortality of weather sensitive species. Ecological changes will generally require several years to become fully evident. Weather modification may interact with other ecological stresses such as air pollution and pesticide application to produce changes greater than the sum of the individual effects. Catastrophic outbreaks of weeds or insect pests are unlikely but not impossible. Big game animals could be adversely affected if snow accumulation is significantly increased on winter range. There does not appear to be an immediate serious threat of environmental contamination from silver iodide or other seeding agents. A global environmental monitoring system is urgently needed. Anticipated kinds of weather modification, effects in semiarid climates and in humid climates, pests and diseases, direct effects of seeding agents, biology of lakes and streams, fog, hail, lightning, and hurricane modification, environmental monitoring programs, inferences from ecological theory, recommended research, and recommended pre-modification field surveys are included in the discussion. (Knapp-USGS)
W70-02323

07. RESOURCES DATA

7A. Network Design

DECADE REPRESENTATIVE AND EXPERIMENTAL RESEARCH BASINS IN THE UNITED STATES.

US Nat Comm Rep for Int Hydrol Decade, 1969. 267 p, 60 map.

Descriptors: *Demonstration watersheds, *Watersheds (Basins), Education, Model studies, Rainfall-runoff relationships, Land management, Water management (Applied), Research and development, Streamflow forecasting.
Identifiers: *Experimental watersheds, Representative watersheds.

The 60 experimental and representative study areas for watershed research in the U.S. are listed, described, and shown by maps. The watersheds are in 22 States and encompass a wide variety of physiographic types and climatic environments. An experimental basin is one that has been chosen and instrumented for the study of hydrological phenomena. A representative basin is one that has been chosen and instrumented to represent a broad area, as an alternative to making measurements in all basins of a comparatively homogeneous region. (Knapp-USGS)
W70-02064

TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
IBM Watson Research Center, Yorktown Heights, N.Y.
For primary bibliographic entry see Field 02J.
W70-02101

7B. Data Acquisition

FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
Geological Survey, Washington, D.C.
Winchell Smith.
Geol Surv Water-Supply Pap 1877, 1969. 54 p, 21 fig, 13 tab, 10 ref.

Descriptors: *Streamflow, *Instrumentation, *Bays, *Deltas, *California, Hydrologic budget, Estuaries, Current meters, Velocity, Acoustics, Stream gages, Discharge (Water).
Identifiers: Acoustic velocity meters, Sacramento River (Calif), Sacrament-San Joaquin Delta (Calif).

A reliable measure of the fresh-water outflow from the Sacramento-San Joaquin delta is needed for the operation of the California Water Project and for the evaluation of the interrelated water problems of the delta and San Francisco Bay regions. The Chipps Island channel, immediately downstream from the confluence of the Sacramento and San Joaquin Rivers, is the most promising site for this flow measurement, but the conventional techniques used for evaluating steady flows cannot be employed there because the channel reach is in the tidal zone, and reversals of flow occur during each tidal cycle. Net outflows, which may be as little as 2,000 cu ft per second must necessarily be computed as the difference between the large ebb-flow and floodflow volumes that move back and forth between the delta region and San Francisco Bay. Discharges during peak periods of the ebb and flood tidal cycles may exceed 300,000 cu ft per second. In consequence, a very high degree of precision must be maintained in the gross flow measurements if meaningful computations of net outflow are to be made. The probable accuracies of an AVM (acoustic velocity meter), a device which measures the stream velocity along a diagonal line across the channel are evaluated. This line velocity will provide a stable index of the mean velocity in the channel and such an index could be used as a primary parameter for the computation of discharge. (Knapp-USGS)
W70-02053

THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
A. G. Gorelik, and V. F. Logunov.
Izvestiya Akademii Nauk SSSR, Seriya Fiziki Atmofery i Okeana, Vol 5, No 5, p 543-545, May 1969. Translated from Russian.

Descriptors: *Rain, *Raindrops, *Wind velocity, *Radar, Instrumentation, Calibrations, Weather forecasting, Meteorology.
Identifiers: *Doppler radar, Meteorological radar.

Doppler radar may be used to find the vertical air velocity in rainstorms. Radar reflectivity is a function of rainfall intensity, average drop-size, and average still-air rainfall velocity. Doppler radar measures actual raindrop velocity; comparison of the still-air and actual velocities yields an estimate of air velocity with an average error of about 1.5 m/sec. (Knapp-USGS)
W70-02056

SUSPENDED SOLIDS MONITORING: A COMPARISON BETWEEN THREE INSTRUMENTS,
University of Strathclyde, Glasgow (Scotland). Dept. of Civil Engineering.
George Fleming.
Water and Water Eng, Vol 73, No 883, p 377-382, Sept 1969. 6 p, 5 fig, 3 photo, 4 tab, 7 ref.

Descriptors: *Suspended load, *Monitoring, *Instrumentation, *Measurement, Analytical techniques, Silting, Sampling, Rivers, Streamflow, Statistical methods, Discharge (Water), Rainfall, Sedimentation, Erosion.
Identifiers: Suspended solids monitoring.

Three commercially available suspended solids monitors were tested under field conditions and a comparison of the results obtained is presented. The monitors are: the Davall Siltmeter, the Southern Analytical Suspended Solids Monitor, and the Fleming Siltmeter. The instruments yield results of similar accuracy when used to measure the suspended solids concentrations in streams. (Gabriel-USGS)
W70-02067

THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
Geological Survey, Washington, D.C.
Robert S. Sigafoos, and E. L. Hendricks.
Geol Surv Res 1969, Prof Pap 650-B, p B89-B93, 1969. 5 p, 1 fig, 1 tab, 9 ref.

Descriptors: *Dating, *Glacial drift, *Dendrochronology, *Trees, Age, Geologic time, History, Climatology, Ecology, Forests, Growth rates, Paleoclimatology, Plant growth.
Identifiers: *Tree establishment (New sediments).

Determining the age of the oldest tree growing on a recent deposit can be a reliable technique for estimating the age of the deposit. The main source of error in such an age estimate is the interval between stabilization of the deposit and germination of tree seedlings. The availability of seed, the presence of a seedbed of fine-grained material, and a favorable climate are the principal controls in the establishment of trees. These conditions are met in valley bottoms at Mount Rainier, Wash., where tree ages were compared with known ages of recently deposited moraines. Based on ages of more than 150 trees growing on surfaces of known age, the interval between sediment stabilization and tree seed germination is estimated to be 5 years for bottomland sites at Mount Rainier. Dating of a recently deposited pumice layer and determining the ages of trees growing on an underlying moraine near timberline show that the interval is longer at high altitudes than at lower altitudes. (Knapp-USGS)
W70-02075

CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
Geological Survey, Columbus, Ohio.
Stanley E. Norris, and Richard E. Fidler.
Geol Surv Res 1969, Prof Pap 650-B, p B158-B161, 1969. 4 p, 3 fig.

Descriptors: *Structural geology, *Aquifers, *Carbonate rocks, *Ohio, *Radioactive well logging, Hydrogeology, Hydrologic data, Permeability, Transmissivity, Geology, Stratigraphy.
Identifiers: Gamma-ray well logging.

Natural gamma logs are a basis for determining the contact between the principal carbonate rock units in northwest Ohio, those of the Niagara and Cayuga Groups. Logs of the upper part of the Niagara Group, a dolomite of high purity, show a relatively low intensity of radiation and are almost featureless, in marked contrast to logs of the slightly less pure dolomite of the overlying Cayuga rocks. A characteristic change in radioactivity at or near the contact is identifiable on most logs in the study area. Data from 26 wells, supplemented by that obtained from quarry exposures, have been used to construct a structure contour map which conforms closely to the known regional structure. This map will be a significant aid in the interpretation of the hydrogeologic system in northwest Ohio. (Knapp-USGS)
W70-02079

REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
Geological Survey, Albuquerque, N. Mex.; Geological Survey, Anchorage, Alaska; and Geological Survey, San Juan, Puerto Rico.
C. H. Scott, V. W. Norman, and F. K. Fields.
Geol Surv Res 1969, Prof Pap 650-B, p B164-B168, 1969. 5 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Tracers, *Adsorption, *Clays, *Dye releases, *Flow measurement, Streamflow, Flow rates, Tracking techniques, Fluorescence, Sediments, Silts, Arid lands.
Identifiers: *Dye adsorption.

Loss of dyes such as Rhodamine WT, Pontacyl Pink B, and Rhodamine B on clays and silts during discharge measurements in streams of the arid Southwest is a potential problem. A study of loss of fluorescence of Rhodamine WT and Pontacyl Pink B on fine sediment from the Rio Puerco near Bernardo, New Mexico showed that the loss was independent of the concentration of dye but was dependent on the concentration of sediment. Also, all the loss took place in less than 30 minutes. The loss of fluorescence may be related to characteristics of the sediment such as mineralogical composition, surface area per unit weight of material, and perhaps others. (Knapp-USGS)
W70-02080

DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 02K.
W70-02099

EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
Illinois State Water Survey, Urbana.
Douglas M. A. Jones.
Monthly Weather Rev, Vol 97, No 8, p 604-606, Aug 1969. 3 p, 2 fig, 4 tab, 8 ref.

Descriptors: *Rain gages, *Calibrations, *On-site tests, Statistical methods, Data collections, Instrumentation.
Identifiers: Rain gage housings, Gage housing effects.

Reduction in catch due to the shape of the housing of the U. S. Weather Bureau standard recording gage was explored using data from Weather Bureau stations with both recording and nonrecording gages, a gaging site which included both a standard nonrecording gage and a Stevens recording gage, and gages on the East Central Raingage Network. The standard 8.0-in. diameter orifice recording gage caught 2.5 to 6% less rain than the nonrecording gage and 2.5% less rain than the recording gage fitted with a 12-in. diameter orifice. The Stevens recording gage caught 5.5% less rain than the nonrecording gage. It is concluded that proximity of a sloping portion of the gage housing on the 8-in. diameter orifice recording gages is responsible for the catch reduction. (Knapp-USGS)
W70-02102

PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
Laboratoire National d'Hydraulique, Chatou (France).
For primary bibliographic entry see Field 08B.
W70-02104

ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
Pittsburgh Univ., Pa. Graduate School of Public Health.
For primary bibliographic entry see Field 05A.
W70-02112

MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
Rothamsted Experimental Station, Harpenden (England).
I. F. Long, and B. K. French.
J Soil Sci, Vol 18, No 1, p 149-166, Mar 1967. 18 p, 10 fig, 1 tab, 10 ref.

Descriptors: *Soil moisture, *Nuclear moisture meters, Temperature, Evaporation, Irrigated land, Barley, Humidity, Grasslands, Hydrogen, Calibrations, Instrumentation.
Identifiers: Field soil moisture measurement.

A soil-moisture neutron probe which uses as a source Am-Be has a boron triflouride detector. A desired linear relationship between thermal neutron count and the volumetric water content is achieved by having the source and detector as close to each other as possible. Field trials were made in 1962 and 1963 in bare clay soil and under barley crop, and in 1964 under timothy and meadow fescue, both irrigated and non-irrigated conditions. The periodic evaporation was in good agreement in the aerodynamic estimates based on humidity, wind profiles and temperature. (Carstea-USGS)
W70-02124

SEEPAGE DETECTION BY REMOTE SENSING,
HRB-Singer, Inc., State College, Pa. Radiometrics Lab.
Thomas R. Ory.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 128-133, Apr 1969. 6 p, 3 photo, 2 tab, 2 chart.

Descriptors: *Seepage, *Remote sensing, Radar, Infrared radiation.

A number of remote sensing techniques have been shown to have application in the detection and evaluation of seepage. Radar and infrared sensors are presently available for use in seepage detection research and, to a limited extent, for operational work. When these sensors are used after a careful analysis of the detection problem, and with utilization of the information available from conventional techniques, the success probability of remote seepage detection should be very good. Future research will undoubtedly yield less expensive and more reliable remote sensors for this application as the payoffs from initial employment begin to stimulate their use.
W70-02169

FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
Idaho Univ., Moscow. Engineering Experiment Station; and Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.
C. E. Brockway, and R. V. Worstell.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 121-127, Apr 1969. 7 p, 2 tab, 3 chart, 6 ref.

Descriptors: *Water measurement, *Seepage, Canal seepage, Ponding, Inflow, Discharge (Water), Flowmeters, Instrumentation.
Identifiers: *Seepage measurement.

Of the available methods for evaluating seepage losses, the ponding test is the most accurate but the most expensive. The use of seepage meters for obtaining estimates is fast and economical. However, new types of meters capable of functioning in canals at operating depth should be studied. Almost all the available meters are capable of measuring seepage with reasonable accuracy at a point, but discretion must be used in the amount of confidence placed in average values determined from meters tests. The procedure outlined for estimating the number of meter tests required can be used to judge the confidence to be placed in any group of tests. Inflow-outflow methods are usually too expensive to be used for short-duration seepage measurements. However, a good installation does indicate seasonal changes in loss rates. Accuracy of inflow-outflow determinations is limited by the flow-measuring devices, but for canals with large seepage losses, inflow-outflow methods may be the most expedient and sufficiently accurate.
W70-02179

FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
Clemson Univ., S.C. Water Resources Research Inst.
Thomas L. Drake.
Available from the Clearinghouse as PB-188 286, $3.00 in paper copy, $0.65 in microfiche. Report

No 11, Water Resources Research Institute, Clemson University, July 1969. 96 p, 62 fig, 21 ref. OWRR Project A-011-SC.

Descriptors: *Resistivity, Exploration, Geophysics, Groundwater, South Carolina, Soundings.
Identifiers: *Induced polarization, Piedmont, Traverses.

The effectiveness of electrical resistivity and electrical induced polarization techniques as an aid in the determination of the subsurface hydrogeologic environments in the Piedmont area of South Carolina is investigated. This investigation involved the simultaneous resistivity and induced polarization soundings and traverses over the somewhat known geologic and hydrologic environments of the Clemson Research Watershed. Results show that the resistivity method generally provided a delineation of the bedrock lithologies, soil and subsoil horizons, overburden saturated with groundwater, and unsaturated overburden. Conclusions are based on twelve lines of resistivity traverses having a total length of approximately 12,000 feet. The Wenner array using a spread of 20 feet, expanded six times to yield a maximum spread of 140 feet, was the primary electrode configuration. Additional resistivity soundings were generally performed every seven stations, 140 feet, with a spread of 2 feet, expanded three times. At selected stations, electrical induced polarization data was acquired. The apparent resistivities of the area range from approximately 210 ohm-meters to about 4,000 ohm-meters. No induced polarization activity was observed.
W70-02241

ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
Harvard Univ., Cambridge, Mass.
Gerhard Tschannerl.
Rep, Int Conf Arid Lands Changing World, June 1969. 31 p, 12 fig, 1 tab, 10 ref.

Descriptors: *Decision making, *Data transmission, *Streamflow, *Stochastic processes, *Hydraulic design, Economic prediction, Reservoirs, Numerical analysis, Statistical methods, Cost analysis.
Identifiers: Deterministic model.

The estimation of the statistical parameters of streamflow as a source of the knowledge required for decision making about the design and operation of hydraulic structures was presented. The objective of the paper was to: (1) show that under certain circumstances data that are correlated with the event that is being studied can be used to get a better design of the hydraulic structure; and (2) describe a way in which this operation can be carried out. A stochastic model and deterministic model were developed for hydraulic variables and for economic input variables respectively. A numerical example illustrated the use of the model. The availability of several sources of data with differing statistical and cost characteristics could be envisaged, from among which a choice could be made. The principles that were discussed could be applied to a wide variety of situations. (Thiuri-Cornell)
W70-02271

SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
Allied Research Associates, Inc., Concord, Mass.
James C. Barnes, and Clinton J. Bowley.
Water Resources Res, Vol 4, No 2, p 257-272, Apr 1968. 16 p, 10 fig, 19 ref. ESSA Contract No Cwb-11269.

Descriptors: *Snow cover, *Photography, *Satellites (Artificial), Watersheds (Basins), Clouds, Networks, Mapping, Winter, Remote sensing, Photogrammetry, Surveys.
Identifiers: *Snow cover mapping, Satellite photography.

Utilizing data from 3 winter seasons, snow cover distributions in the relatively flat terrain of the Missouri and Upper Mississippi River basins are mapped from satellite photography. Techniques are developed for identifying snow cover and for differentiating between snow and cloud. Comparisons between snow data observed by satellites and snow data conventionally acquired indicate that, in almost all cases, snow can be distinguished from cloud on the bases of current cloud reports, pattern continuity, landmark identification, and texture. Snow cover can be mapped from Tiros or Essa resolution photography with an accuracy of approximately 20 miles, often providing a more detailed mapping than can be obtained from conventional station networks. Qualitative estimates of snow depth can also be obtained from satellite photography. In nonforested areas, reflectivity increases with snow depth, until an accumulation of about 4 to 6 inches is reached; after that, the reflectivity remains unchanged. In forested areas, no discernible relationship between reflectivity and snow depth is observed. (Carstea-USGS)
W70-02314

LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-02316

STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
Colorado State Univ., Fort Collins. Dept of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-02330

7C. Evaluation, Processing and Publication

GROUNDWATER LEVELS IN THE UNITED STATES, 1962-66, NORTH-CENTRAL STATES,
Geological Survey, Washington, D.C.
C. L. McGuinness.
Geol Surv Water-Supply Pap No 1976, 1969. 117 p, 10 fig.

Descriptors: *Water levels, *Observation wells, Water wells, Networks, Data collections, Hydrologic data, Aquifers.
Identifiers: North Central U.S.

Data from the basis network of observation wells in the North Central States, 1962-66 is tabulated. Each record includes well location, well number, owner, type and construction, aquifer, diameter, depth, casing type, gage type and history, record high and low water levels, and a table of periodic observations. (Knapp-USGS)
W70-02044

VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
Geological Survey, Washington, D.C.
John J. Hickey.
Geol Surv Water-Supply Pap 1879-E, p E1-E33, 1969. 33 p, 1 plate, 1 tab.

Descriptors: *Channel morphology, *Alluvial channels, *Streambeds, *California, Stream erosion, Aggradation, Sedimentation, Scour, Surveys.
Identifiers: *Streambed elevations.

Graphs and a table are presented showing the variations in streambed elevations that have occurred over the years in the low-water channels at selected gaging stations in northwestern California. The streambed elevations are calculated from data obtained during discharge measurements. The greatest elevation changes that were recorded occurred between the 1964 and 1965 low-water periods. Those streambed changes are related to the flood of December 1964 and probably reflect large quantities of sediment placed in the streams from bank erosion and landslides. At 25 of 51 stations with data for that period, elevation changes exceeded 1 foot, and at 42 stations the changes represented fill, rather than scour. (Knapp-USGS)
W70-02045

AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
Soil Conservation Service, Beltsville, Md.

Avail from Superintendent of Doc, US Government Printing Office, Wash, DC, 20402 -- Price $0.75. Soil Conserv Agr Handbook 294, Oct 1966, Reprinted 1968. 89 p, 68 fig, 2 tab, 19 ref.

Descriptors: *Mapping, *Aerial photography, *Photogrammetry, *Soil surveys, Soil investigations, Geologic mapping, Hydrography, Terrain analysis, Topography.
Identifiers: Soil mapping.

The use of aerial photographs in making soil surveys is explained in a manual intended primarily for soil scientists and others directly engaged in the national soil survey of the U.S. The principles should be of use to anyone else working in soil mapping, geological mapping, or air photograph interpretation. (Knapp-USGS)
W70-02066

APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-02078

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
Geological Survey, Washington, D.C.

Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 -- Price $2.00. Geol Surv Water-Supply Pap 1955, 1969. 440 p, 1 fig, 32 ref.

Descriptors: *Data collections, *Surface waters, *Water quality, Lakes, Reservoirs, Water temperature, Sediment discharge, Turbidites, Water chemistry, Chemical analysis.
Identifiers: Surface water records, Water quality records, Water resources data, Ohio River Basin, St. Lawrence River Basin.

The surface-water records for the 1964 water year for gaging stations, partial-record stations, and miscellaneous sites in the Ohio and St. Lawrence River Basins are presented. The data generally comprise a description of the station and tables showing the results of water quality measurements of the stream. The description of the station gives the location, drainage area, records available, and general remarks. Chemical quality, fluvial sediment, and water temperatures are listed. The chemical quality includes concentrations of individual dissolved constituents, hardness, specific conductance, and pH. Fluvial-sediment information is given for suspended-sediment discharges and concentrations. Water-temperature data represent once-daily observations except for stations where a continuous temperature recorder furnishes information from which daily minimums and maximums are obtained. (Knapp-USGS)
W70-02114

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
Geological Survey, Washington, D.C.

Avail from Superintendent of Doc, US Government Printing Office, Wash DC, 20402 -- Price $2.75. Geol Surv Water-Supply Pap 1954, 1969. 606 p, 1 fig, 32 ref, index.

Descriptors: *Data collections, *Surface waters, *Water quality, Lakes, Reservoirs, Water temperature, Sediment discharge, Turbidites, Water chemistry, Chemical analysis.
Identifiers: Surface water records, Water quality records, Water resources data, Eastern U.S.

The surface-water records for the 1964 water year for gaging stations, partial-record stations, and miscellaneous sites in the North Atlantic Slope basins, South Atlantic Slope, and Eastern Gulf of Mexico basins are presented. The data generally comprise a description of the station and tables showing the results of water quality measurements of the stream. The description of the station gives the location, drainage area, records available, and general remarks. Chemical quality, fluvial sediment, and water temperatures are listed. The chemical quality includes concentrations of individual dissolved constituents, hardness, specific conductance, and pH. Fluvial-sediment information is given for suspended-sediment discharges and concentrations. Water-temperature data represent once-daily observations except for stations where a continuous temperature recorder furnishes information from which daily minimums and maximums are obtained. (Knapp-USGS)
W70-02115

CHART HOLDER USES OLD TYPEWRITER PARTS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Willie R. Curtis, and David N. Tolsted.
Agr Eng 48 (3): p 154-155, 1967.

Descriptors: *Hydrograph analysis, *Charts, *Hydrographs, *Data processing, Discharge measurement, Research equipment, Water measurement.

Describes a useful tool for use in converting streamflow hydrographs to amount of flow. Especially adapted to FW-1 water-level charts.
W70-02205

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I and II,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 10.
W70-02235

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
Texas A and M Univ., College Station. Water Resources Inst.
For primary bibliographic entry see Field 10.
W70-02236

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 10.
W70-02237

WATER RESOURCE OBSERVATORY SOLAR RADIATION DATA-WATER YEAR 1969 AND PRIOR.
Wyoming Univ., Laramie. Water Resources Research Inst.

Paul A Rechard - Coordinator. Available from the Clearinghouse as PB-188 287, $3.00 in paper copy, $0.65 in microfiche. Water Resources Series No 16, Oct 1969. 39 p, 1 tab, 1 fig. OWRR Project A-001-WYO.

Descriptors: *Solar radiation, *Data collections.

Incident, reflected and absorbed solar radiation data from various locations operated by the University of Wyoming in and adjacent to Laramie, Wyoming are presented in tabular form. The period covered is from November 1966 to October 1969.
W70-02242

NON-LINEAR PROGRAMMING AS A METHOD OF DESION OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
Stanford Univ., Calif.
For primary bibliographic entry see Field 05D.
W70-02243

SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION: AN APPLICATION OF MULTIVARIATE STATISTICS,
Toronto Univ. (Ontario); and Scarborough Coll., Toronto (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 02J.
W70-02303

STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
Manhattan Coll., Bronx, N.Y. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05A.
W70-02326

THERMAL MODIFICATION OF RIVER WATER QUALITY,
Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
R. T. Jaske.
Sixth Biennial Hydraulics Conference, Pullman, Washington, Oct 18, 1967. Mss 16 p, 7 fig, 4 ref.

Descriptors: *Temperature, *Heat, *Temporal distribution, *Columbia River basin, Seasonal, Reservoirs, Temperature control, Statistical methods, Least squares method.

The influence of reservoirs on water quality below them was demonstrated in the Columbia River. The river temperature data were evaluated statistically using the formula T= A+ B sin (Cd+ D) using a digital computer. The analysis resulted in the following conclusions by the author: (1) The erection of hydraulic power dams and reservoirs on the Columbia River has had only a nominal effect on the annual mean temperature of the entire system. This change is less than one degree C. (2) The erection of these projects has significantly altered the timing of the annual temperature and has to a limited extent altered the seasonal extremes. (Novotny-Vanderbilt)
W70-02408

08. ENGINEERING WORKS

8A. Structures

DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
American Pipe and Construction Co., Monterey Park, Calif.
Gordon G. Robertson.
J Amer Water Works Ass, Vol 61, No 7, p 339-342, July 1969. 4 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Gaskets, *Shear stress, Test procedures, Pressure pipes, Pressure, Deformation, Pipes, Pipelines, Stress distribution, Failures shear strength, Concrete pipes, Ultimate tensile strength, Steel pipes, Gaskets.
Identifiers: *O-ring seals, *Pipe joints, Test results, Cast iron pipe.

Circular cross-section rubber gaskets called O-rings have a long history of operation as sealing elements in pressure pipe joints. The sealing action is dependent on contact pressure between the gasket and mating surface. Measurements of gasket contact pressure indicate that an arch-shaped pressure distribution exists across the gasket contact area, and that the peak contact pressure always exceeds the applied hydrostatic pressure. The seal cannot leak as long as the gasket remains within its groove and maintains its structural integrity. Determining stress within a confined circular gasket under pressure is a complex procedure. M. G. Sotenskii's equation for calculating the pressure at which shear failure will take place is presented. One simplified approach uses limited scope testing for stress measurements. Guidelines for application to design problems are discussed. (USBR)
W70-02133

THE SEISMIC EVENTS AT KOYNA DAM,
California Inst. of Tech., Pasadena.
G. W. Housner.
Pap, Calif Inst Tech, Pasadena, May 1969. 25 p, 9 fig, 1 tab, 23 ref.

Descriptors: *Earthquake engineering, *Earthquakes, *Dams, Engineering geology, Concrete dams, *Reservoirs, Seismic design, *Seismology, Faults (Geology), Seismic studies, Geology, Geophysics, Foreign projects, Shear stress, Bibliographies, Hydrostatic pressure, Accelerographs, Water pressure, Seismographs.
Identifiers: Earthquake damage, Dam stability, *Seismic sources, Koyna Dam, India, Seismic stability, Tectonic loads.

Filling Koyna Dam reservoir in Peninsular India was accompanied by numerous micro-earthquakes followed by more than a dozen other quakes having magnitudes greater than 5.0. The greatest shock, with a magnitude of 6.5, caused significant damage to the dam and adjacent town. These seismic events occurred in a region supposedly very stable with very low seismicity, and have practical implications for geologists and engineers. Water in the reservoir very likely triggered the swarms of micro-earthquakes that preceded and presumably triggered the greatest 6.5 shock. Whether the triggering is attributable, however, to an increase in gravitational stresses, an increase in water pressure, or both, is not clear. A region considered to be very stable and having very low seismicity can contain volumes of rock having tectonic stresses sufficiently large to produce destructive earthquakes. The fact that Koyna Dam survived a measured 50% g acceleration when it was designed for 5% g indicates that conventional equivalent static design methods are not realistic. (USBR)
W70-02146

ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 07B.
W70-02271

DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
Texas Tech Univ., Lubbock. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 04B.
W70-02282

8B. Hydraulics

HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
Utah State Univ., Logan. Coll. of Engineering.
Harl E. Judd, and Dean F. Peterson.
Utah Water Res Lab Rep PRWG 17-6, Aug 1969. 115 p, 61 fig, 10 tab, 31 ref, 2 append.

Descriptors: *Open channel flow, *Alluvial channels, *Turbulent flow, *Roughness (Hydraulic), Fluid friction, Sediment transport, Dunes, Sand waves, Model studies, Hydraulic models, Flow re-

sistance, Dimensional analysis, Sedimentation, Hydraulics.
Identifiers: Large bed elements (Hydraulic).

Theoretical means of characterizing size, size distribution, spacing, and shape of bed elements are discussed in hydraulically significant terms for large bed element streams; these are related to flume experiments using simulated beds. Observed bed and flow characteristics are reported for a number of natural-stream study sites and the effect of roughness, depth, and slope on flow characteristics of natural streams are analyzed. Possibilities for use of large bed elements in open channel design are suggested. Large elements, derived from valley walls or ancient fluvial or glacial action are moved, if at all, only under conditions of extreme flood. Unlike those in finer sediments, the beds of such streams remain relatively fixed between major flood events and, most of the time, transport of sediments is small. With large relative roughness heights the commonly accepted logarithmic velocity distribution does not apply. Though relatively little attention has been given to flow characteristics in streams in the last two groups, the existence of such streams is common. (Knapp-USGS)
W70-02070

HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
Geological Survey, Fort Collins, Colo.
For primary bibliographic entry see Field 02J.
W70-02074

A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
Bundesanstalt fuer Wasserbau, Karlsruhe (West Germany).
Karl Felkel.
English summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 5-23, 1969. 19 p, 7 fig, 5 tab, 5 ref.

Descriptors: *Sediment transport, *Bed load, *Computer programs, Streambeds, Rivers, Equations, Mathematical models, Programming languages, Engineering structures.
Identifiers: Meyer-Peter and Muller formula, Bed-load transports.

The bottom and water level changes occurring in rivers with bed loads can be calculated by a method using numerous consecutive small distances and intervals of time. The basic equations for such a computer program are briefly discussed. The bed-load balance of each of the river stretches is used for calculating the rising or deepening of the bottom during the selected time interval. The mathematical model is restricted to the calculation of the bed-load transport as a result of natural current. The Meyer-Peter and Muller formula of bed-load transport was used. The sequence of calculations is presented in a detailed structure diagram. The computer program written in ALGOL language is given. (Carstea-USGS)
W70-02103

PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
Laboratoire National d'Hydraulique, Chatou (France).
Cl. Gemaehling, and J. Cl. Lebreton.
English summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 25-49, 1969. 25 p, 6 fig, 1 tab, 22 ref.

Descriptors: *Discharge measurement, *Bed load, *Channels, *Sediment transport, River training, River beds, Dams, Channel erosion, Suspended load, Reservoirs, Discharge (Water), Diversion structures, Aggradation, Analytical techniques, Tracers, Tracking techniques.
Identifiers: Montelimar reservoir.

River training works have brought new problems on channel stability, sediment transport, river bed degradation below dams, upstream aggradation, etc. The mechanisms of bed-load transport and the formulae to compute the maximum bed load are reviewed. In particular, the nuclear techniques are very useful in calculating the rate of bed load. Channel transitions such as junctions and expansions at port entrances, sediment transport (bed load and suspended load) following construction of control dams and diversion canals are discussed. Nomographs relating the river discharge (Q) to reservoir discharge (q) and reservoir level are useful during floods. This diagram makes it possible to ascertain how flow rates at every location on the retained reach have been affected by structural development. (Carstea-USGS)
W70-02104

SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
Netherlands Rijkswaterstaat, Arnhem; and Waterloopkundig Laboratorium, Delft (Netherlands).
R. P. Sijbesma, M. De Vries, and A. Zanen.
French summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 51-64, 1969. 14 p, 10 fig, 1 photo, 1 tab, 6 ref.

Descriptors: *Channeling, *River regulation, *Sediment transport, Sands, Navigation, Locks, River beds, Hydraulic models, Streamflow, Sediment load, Bed load, Mathematical models, Sediment discharge.
Identifiers: *Lower Rhine River, Netherlands, Meyer-Peter and Muller formula.

Shortly after crossing the German border into the Netherlands, the Rhine divides twice: first near Pannerden in the Waal and in the Pannerden Canal and second at Westervoort into the Lower Rhine. The Lower Rhine should be canalized in order to improve navigation. One of the most important aspects of the contemplated improvements was the stability of the river beds following the canalization works. The Meyer-Peter and Muller formula was used in computation of sediment transport. The investigation also involved: (1) the construction of hydraulic models of the river bifurcations for experimental tests on the division of water and sand flows of various rates; (2) mathematical models for treating the results of the hydraulic models and (3) other partial hydraulic models for individual structures. (Carstea-USGS)
W70-02105

THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
Institut d'Armenagement et d'Economie de l'Eau, Warsaw (Poland).
M. Z. Kornacki.
English summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 65-73, 1969. 9 p, 5 fig.

Descriptors: *Erosion, *Chutes, *Navigation, River training, River beds, Downstream, Slopes, Sands, Gravels, Flow, Dams, Streamflow, Hydraulics.
Identifiers: *Poland, Vistula River, Oder River.

Investigations are being carried out in Poland on changes occurring in river beds and on conditions of free flow below improvement works. In particular, studies were conducted below 4 dams on the Vistula and Oder Rivers. The navigation conditions downstream from the fall of a low sill were improved by the training works. The river bed was composed of sandy and gravelly formations and the slopes ranged between 0.25 and 0.32 parts per thousand. (Carstea-USGS)
W70-02106

SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
Direccao Geral dos Servicos Hidraulicos, Lisbon (Portugal); and Laboratorio Nacional de Engenharia Civil, Lisbon (Portugal).
J. F. Ferreira, and L. V. Cunha.
French summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 75-106, 1969. 32 p, 26 fig, 12 ref.

Descriptors: *River regulation, *Floods, *Engineering structures, Flood protection, Irrigation, Hydroelectric power, Navigation, Dams, River beds, Sedimentation, Erosion, Bed load, Suspended load, Sediment discharge, Mathematical models, Hydraulic models.
Identifiers: *Portugal, Mondego River, Meyer-Peter and Muller formula, Einstein formula.

The Mondego River, Portugal is to be regulated to protect against floods, to provide irrigation facilities for 44,000 ha, to increase hydroelectric power, and to improve conditions of navigation. These purposes are served by two dams located in the upper catchment area. Particular care had to be exercised to insure stability of the river bed and thus to avoid sedimentation or erosion. Bed load and suspended load were measured at Coimbra and Villa Pouca over a number of years. The Meyer-Peter and Muller, and Einstein formulae were used for computations. The sediment discharge measured at Villa Pouca represents 40% of the sediment reaching Coimbra. The river bifurcation and the tributaries below Coimbra complicate the project. Mathematical and physical models were constructed to cope with these problems. (Carstea-USGS)
W70-02107

CANAL SHOALING STUDIES,
Corps of Engineers, Vicksburg, Miss.
Ernest B. Lipscomb, and John J. Franco.
French summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 107-121, 1969. 15 p, 5 fig, 1 tab, 8 ref.

Descriptors: *River training, *Channel improvement, *Sedimentation, *Erosion, *Bed load, Channels, Locks, Engineering structures, Dredging, Missouri River, Mississippi River, Sediment discharge, Streams, Model studies, Hydraulic models.
Identifiers: *Arkansas River, Training structures.

Shoaling problems in regulated rivers can be expected at mouths of tributaries, in crossings, in long straight reaches or in long flat bends where the channel tends to be unstable, and in lock approaches. Some maintenance dredging will be required in most waterways where there is sediment moving into or within the waterway. Maintenance dredging appears to be the only practical solution in the lower lock approach. The problem of bed-material load at the mouths of tributary streams can be solved by the proper application of the dominant discharges in the design of the channel and by training structures. Some of the problems experiences on the Missouri River and the Upper Mississippi River and those investigated in model studies conducted in connection with the development of navigation on the Arkansas River are discussed. Model studies are effective means of investigating many of sedimentation and sonar problems. (Carstea-USGS)
W70-02108

MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
Ministry of Irrigation (Egypt). Delta Barrage.

French summary. 22nd Int Navigation Congr, Paris, Sec 1, Inland Navigation, Subj 5, p 123-136, 1969. 14 p, 13 fig, 3 tab.

Descriptors: *Model studies, *Shoals, *Navigation, *Canals, Hydraulic models, Sediments, Sedimentation, Deposition (Sediments), Erosion, Flow profiles, Dredging, Prototype tests, Sands.
Identifiers: *Ather-El-Nabi channel, Nile River, Shoal prevention.

A model test was made of the Ather-El-Nabi Ship Canal, Eastern Branch of the Nile, for solving

problems of sediment deposition at the bifurcation and at the point of re-entry into the Nile. The experiment was undertaken to investigate the best alignment for the canal's entry, the flow pattern at the exit and deposition and erosion in the canal itself. The best scale for the proper representation of prototype conditions was found to be 1:100 horizontal and 1:50 vertical. Several experimental runs were conducted to find the best alignment for the entrance. Shoals are likely to recur so dredging may still prove necessary. (Carstea-USGS)
W70-02109

ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
Universidad Central de Venezuela, Caracas.
A. Zagustin, and K. Zagustin.
La Houille Blanche, No 2, p 113-118, 1969. 6 p, 3 fig, 2 ref, append.

Descriptors: Turbulence, *Turbulent flow, *Pipe flow, Fluid mechanics, *Closed conduit flow, Foreign research, Steady flow, Hydraulics, Fluid flow, *Velocity distribution.
Identifiers: Venezuela, Prandtl theory, Von Karman method, Mixing length, Karman constant.

An equation is presented for the analytical solution of turbulent flow in a smooth pipe. The solution is obtained without making empirical or semi-empirical assumptions on the mixing length distributions, as is done in the theories of Prandtl and Von Karman. The proposed method is developed from a balance of pulsation energy equation, representing the balance between the rate of energy lost because of molecular motion and the flux of turbulent energy produced at the wall. The method shows excellent agreement with experimental results at the neighborhood of the wall and throughout the pipe. The final expressions depend on only one experimental constant, the Karman universal constant. Graphs are presented, using the standard accepted value of Karman's constant as 0.40; using a slightly lower value of 0.395 or 0.39 gives even better agreement with experiments. The expression for velocity distribution coincides with Darcy's empirical formula of 1885 at the centerline, and with Prandtl's expression at the neighborhood of the wall. (USBR)
W70-02136

MECHANICS OF BED FORMATIONS,
Robert Coll., Istanbul (Turkey).
F. Senturk.
La Houille Blanche, No 2, p 163-172, 1969. 10 p, 17 fig, 2 tab, 8 ref.

Descriptors: Sands, *Sand waves, Sediments, *Streambeds, Beds, Under water, Dunes, Channel flow, Hydraulics, Hydraulic models, *Flow resistance, Hydraulic radius, *Configuration, Fluid mechanics, Foreign research.
Identifiers: *Bed movements, Bed profiles, *Bed resistance, Turkey, *Bed ripples, Bed roughness, Rippled surfaces, Channel beds.

The bed formation mechanics of nonuniformly sized sand are examined. Hydraulic conditions can be defined for a state of flow under which sand particles do not move. A further range of conditions exists were sand grains are in motion but do not develop sand configurations. Above a limit, particle movements are accentuated and bed configurations develop rapidly. The formation of ripples, antiripples, dunes, and antidunes is discussed. Grain size has a direct influence on the increase in flow resistance as the bed changes from a plane form to a wavy form. Bed configurations move much more rapidly than individual sand particles. The difference in velocity between sand grains and the movement of configurations causes the change in wave forms. Resistance of the bed to flow is a function of bed configuration and can be classified into 4 types of resistance characteristics according to bed configurations. (USBR)
W70-02149

EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
Mississippi State Univ., State College; and Auburn Univ., Ala.
E. Dale Threadgill, and Ronald E. Hermanson.
Trans Amer Soc Agr Eng, Vol 12, No 3, p 352-355, May-June 1969. 4 p, 2 fig, 3 tab, 13 ref.

Descriptors: *Rainfall, *Velocity distribution, Bank erosion, Sensors, *Tractive forces, *Open channels, Laboratory tests, Stream erosion, Hot film anemometers, Hydraulics, Shear forces, Rainfall intensity, Rainfall simulators, Sediment transport, Instrumentation.
Identifiers: Velocity gradient, Prandtl-Von Karman equation.

A study was made to determine effects and significance of rainfall on the velocity distribution and tractive force in a shallow channel having a cross section approximating that of a natural channel. Simulated rainfall at intensities of 5, 12, and 20 iph was applied to the flow in a shallow, triangular channel. Conclusions were: (1) vertical velocity distribution is logarithmic with and without rainfall; (2) rainfall significantly reduced the velocity of flow throughout the entire cross section with the magnitude of this effect decreasing with decreasing rainfall intensity; this effect was more pronounced for flow over rough boundaries; (3) rainfall had no significant effect on the vertical velocity gradient; (4) rainfall caused a decrease in tractive force in the deeper regions of flow and an increase in tractive force in the shallow regions, but the magnitudes of these effects were not significant; (5) the Prandtl-Karman expression should not be identical for the velocity distribution near rough and smooth boundaries when referred to average velocity; and (6) coefficients for the Prandtl-Karman velocity distribution equation were developed from pipe flow data, and did not apply for the velocity distributions studied. (USBR)
W70-02174

LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
Puerto Rico Univ., Mayaguez. Water Resources Research Inst.
Christos Hadjitheodorou.
PB-188 509. Water Resources Res Inst Proj Completion Rep, Puerto Rico Univ, June 1969. 31 p, 7 fig, 13 ref, 1 append. OWRR Proj No A-011-PR.

Descriptors: *Turbulent flow, *Alluvial channels, *Meanders, *Open channel flow, *Energy losses, Waves (Water), Shear, Jets, Energy equation, Model studies, Hydraulic models, Mathematical models, Flow around objects, Friction, Head loss, Roughness (Hydraulic), Hydraulics.
Identifiers: *Flow loss.

Energy losses in meandering streams were studied with flumes with movable beds and analyzed mathematically. With a movable bed, energy loss is greater than with a fixed bed because of the formation of point bars at the inside of bends. These bars increase the loss by acting as obstacles to flow. Channel shear stress is increased, turbulence is increased, flow separation may further increase the loss, and waves are formed which increase loss by wave drag. Data are presented as plots of Froude numbers vs loss coefficients. The analytical solution uses the theory of ideal jet flow, in which gravity is the predominant force and surface waves are neglected. (Knapp-USGS)
W70-02287

CATALOG OF TSUNAMIS IN ALASKA,
Hawaii Univ., Honolulu; and Coast and Geodetic Survey, Honolulu, Hawaii.
For primary bibliographic entry see Field 02L.
W70-02289

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
Texas Univ., Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 04A.
W70-02322

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I: FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 02H.
W70-02393

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II: TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 02H.
W70-02394

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III: TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
For primary bibliographic entry see Field 02H.
W70-02395

8C. Hydraulic Machinery

EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
Politekhnicheskii Institut, Leningrad (USSR).
L. P. Grianko, and V. G. Staritskii.
Trudy Leningrad Polytek Inst, No 297, p 63-67, 1968. Transl from Russ, Bur Reclam Transl 579, Aug 1969. 15 p, 6 fig, 5 ref, append.

Descriptors: *Hydraulic machinery, *Hydraulic turbines, Foreign design practices, Model tests, *Turbine runners, Laboratory tests, Cavitation, Efficiencies, Research and development, Mechanical engineering, Testing machines, Hydraulics, Surges, Turbulent flow, Discharge measurement, Hydraulic design, Foreign research.
Identifiers: USSR, Leningrad Poly Inst (USSR), Krasnoiarsk Powerplant (USSR), *Machine design, Comparative studies.

The Hydraulic Machinery Laboratory at Leningrad Polytechnic Institute, USSR, has developed a combined Francis and propeller runner to fit the operating conditions and dimensions of Krasnoiarsk Hydropowerplant. Models of 2 alternative designs of this runner were tested and data compared with that of Francis Runner RO-697 used at Krasnoiarsk. The only dimensional design change is that the flare angle of the lower band is 13 deg instead of the 20 deg of RO-697. Since specific speed and discharge capacity of the combined runner are significantly higher than for RO-697, using this runner at Krasnoiarsk would increase unit capacity at the generator to 580 mw and reduce the total number of units by one. Energy factors for the improved model design showed that efficiency was only 0.5 or 1% less than that of RO-697. Cavitational qualities were about equal. Pressure surges beyond the new runner were 30-40% lower than beyond RO-697, reducing turbulence in design operating conditions and also during startup at reduced heads. The greater discharge capacity of the combined runner will increase its operational reliability over that of RO-697. (USBR)
W70-02138

EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
A. Ia. Aronson, N. F. Berkhov, and E. M. Kagan.
Energomashinostr, No 4, p 32-33, 1969. Transl from Russ, Bur Reclam Transl 717, Aug 1969. 6 p, 1 fig, 2 ref.

Descriptors: *Hydraulic turbines, Hydraulic machinery, Manufacturing, Turbine runners, Turbine blades, Francis turbines, *Stress analysis, Mechanical engineering, Stress distribution, Stress, Graphical analysis, *Tolerances (Mechanics), Errors, Foreign research, Mathematics, Design data.
Identifiers: USSR, Krasnoiarsk Powerplant (USSR), Comparative studies, Aswan Dam (UAR), Machine design.

To assure reliability in manufacturing runners for large Francis hydraulic turbines, an accurate method of evaluating stress distribution in runner parts is necessary. Manufacturing quality, including deviations from permissible manufacturing tolerances, has an important effect on stress distribution. Six geometric dimensions from manufacturing data of Krasnoiarsk and Aswan blades were used for evaluating the effect of tolerances on the stress state of runners. Stress distribution was determined by the usual methods, and confidence areas were computed and plotted on a distribution curve. The maximum variation in stresses, caused by deviations from geometric dimensions in manufacturing, reached 10% for leading edges and 50% for trailing edges of Krasnoiarsk and 15% and 60% for Aswan. Manufacturing tolerances for Aswan were set by recomputing the Krasnoiarsk tolerances by a proportional ratio of runner diameters, but the relative tolerances of both runners had a confidence area differing by 1.5 to 2.0 times. The stress variation was not caused by geometrical dimensions but by geometrical characteristics, such as area or moments of inertia. Stress variations must be considered in evaluating runner strength. (USBR)
W70-02139

EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
Bureau of Reclamation, Denver, Colo.
J. J. Cassidy.
Bur Reclam Rep No HYD-591, May 1969. 31 p, 20 fig, 3 tab, 12 ref.

Descriptors: *Draft tubes, *Turbines, *Hydraulic turbines, *Surges, Hydraulics, Hydroelectric plants, Hydraulic machinery, Fluid mechanics, Dimensional analysis, Air, Unsteady flow, Pressure, Laboratory tests, Model tests, Fluid flow, Non-uniform flow, Reynolds number.
Identifiers: Fluid dynamics, Hydraulic resonance.

Draft-tube surge experiments were conducted with models of draft tubes, using air as the fluid. The occurrence, frequency, and amplitude of surges were correlated with flow and draft-tube geometry variables. Studies show that surges arise when angular momentum reaches a critical value relative to linear momentum. Surge frequency and peak-to-peak pressures are independent of viscous effects for Reynolds numbers above 80000, and are correlated with a dimensionless momentum parameter for a particular draft-tube shape. A criterion is given for predicting the surging threshold. Results of the study are applied to analyses of draft-tube surging in the Fontenelle and Hoover replacement turbines. (USBR)
W70-02157

EVAPORATION FOR DESALINATION,
Polytechnic Inst. of Brooklyn, N.Y.
For primary bibliographic entry see Field 03A.
W70-02158

STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
Brown, Boveri and Co. Ltd., Baden (Switzerland).
J. Kauferle, and E. Proll.
Brown Boveri Rev, Vol 56, No 3, p 112-120, Mar 1969. 9 p, 8 fig, 9 ref.

Descriptors: *Extra high voltage, *Alternating current, *Direct current, *Electrical stability, Electrical studies, Simulation, Errors, *Transmission (Electrical), Electric power, Faults (Electrical), Power factors, Foreign research, Differential equations, Electric generators, Oscillation, Oscillographs, Analog computers, Electrical networks.
Identifiers: Switzerland, *Transient stability, Interconnected systems.

Because of ease of control, an hvdc transmission system can be used to influence the stability of associated ac networks. To improve stability, appropriate signals derived from the network characteristics are fed into the hvdc control system. The manner in which an hvdc system, with and without means of improving stability, influences the steady-state and transient stability of an ac network is examined. The model system chosen for the investigation was an equivalent network, consisting of generator and passive load, supplying an infinite network via an ac line and a parallel hvdc link. The study considered the influence of the hvdc link on electromechanical oscillations between the 2 networks while varying the steady-state power distribution within broad limits. The primary concern was performance when small faults occur (steady-state stability). Effects created by short circuits on the ac tieline (transient stability) were also studied. (USBR)
W70-02171

8D. Soil Mechanics

GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
Bureau of Reclamation, Sacramento, Calif.
For primary bibliographic entry see Field 08E.
W70-02131

STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
G. K. Klein, and I. V. Gavrichenkova.
Soil Mech Found Eng, No 6, p 405-411, Nov-Dec 1968. 7 p, 6 fig, 4 ref.

Descriptors: *Towers, *Structural stability, *Stability, Foundations, *Footings, Moments, Bending, *Bending moments, Deformation, Deflection, Elastic deformation, Plastic deformation, Structural behavior, Pressure distribution, Structural design, Stress distrubution, Soil pressure, Foreign activities, *Transmission towers.
Identifiers: Rigid structures, Deformable soils, Reactive loads, USSR, Static behavior.

A structure may lose stability as a result of the combined action of moments and virials of forces acting on the structure reaching limiting values. Structures having rectangular, circular, and ring footings are considered for various cases of reactive pressure distribution in the soil under the footings. Relationships between limiting values of moments and limiting values of virials are developed for situations resulting from separate action and from combined action of moments and virials. Soil under the footings is assumed to be locally deformable. The structure is considered first to be absolutely rigid. After finding the angle of inclination for the rigid structure, the secondary moments and deformations caused by bending of the tower are determined by the method of successive approximations. Then the angle of inclination of the tower, allowing for deformation, can be found and the tower can be designed for stability. A sample problem shows that the influence of virials compared to axial compressive forces and bending moments is insignificant and, for design of rigid structures, can be disregarded. (USBR)
W70-02141

FEASIBILITY OF COLD WEATHER EARTHWORK,
Purdue University, Lafayette, Ind.
C. W. Lovell, Jr., and A. M. Osborne.
Joint Highw Res Proj, No 1, Purdue Univ, Lafayette, Ind, Feb 1968. 23 p, 6 fig, 2 tab, 14 ref.

Descriptors: *Earthworks, *Cold weather construction, *Cold regions, Construction, Frozen soils, Frost, *Excavation, Frozen ground, Winter, Compaction, Moisture content, Feasibility, Economics, Construction costs, Benefits, Annual costs, Personnel.
Identifiers: Low temperature, *Highway engineering.

Most earthwork operations are more costly during cold weather. However, the benefits of keeping construction forces and equipment continuously operative and advancing the completion date of a modern and safer facility may more than compensate for increases in unit costs. Cold weather earthwork experiences in the northern United States, the provinces of Canada, and the Scandinavian countries have been studied. The effort has served to define: (1) the manner in which winter weather and soil conditions tend to restrict construction season length; (2) design and construction practices that have been employed to cope with winter conditions; and (3) an estimate of relative unit costs for various winter operations. Advantages of cold weather earthwork have been defined in a simple linear economic model. An assessment of deterrents and benefits concludes that cold weather earthwork is economically and technically feasible on many highway projects in the frost area of North America. (USBR)
W70-02142

COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
Pressure Grout Co., Daly City, Calif.
Edward D. Graf.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM5, p 1151-1158, Sept 1969. 8 p, 4 fig.

Descriptors: *Compaction, *Grouting, *Foundations, *Soil compaction, Lift, Soil density, Settlement, Settlement (Structural), Differential settlement, Buildings, Equipment, Construction equipment, Construction materials, Mudjacking, Soil engineering, Soil mechanics, Radial stress.
Identifiers: Grouting pressure, Grout mixes, Leveling, Radial loads, Lifting devices, Empirical methods, Construction methods.

Compaction grouting is a specialized technique used for controlled densification of in situ soils at depth by displacing soil particles radially from a controlled, growing bulb of grout. Observations of many jobs have empirically established that compaction grouting is an effective and economic method of compacting most sands, silts, unsaturated clays, and organic materials. Major applications include underpinning and leveling structures that have suffered differential settlement. Theory, outline of basic techniques, equipment and materials, observations, and empirically derived conclusions are presented. (USBR)
W70-02165

THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
Colorado Univ., Boulder; and Geological Survey, Denver, Colo.
T. C. Nichols, Jr., and Ernest E. Wahlstrom.
Eng Geol Int J, Vol 3, No 2, p 149-174, Apr 1969. 26 p, 18 fig, 4 tab, 3 ref.

Descriptors: *Landslides, Slopes, Slope stability, Shear strength, Slope stabilization, Sliding, Geologic investigations, *Engineering geology, Clays, Weathering, *Petrographic investigations, Shear planes, Soil engineering, Swelling, Damsites, Expansive clays, Excavation.
Identifiers: Dillon Dam (Colo), Activation.

During construction of Dillon Dam in 1960, excavation at the left abutment cut the toe of an old, relatively stable landslide reactivating the slide. The slide threatened to bury the intake structure and portal of the outlet tunnel. Landslide investigations included laboratory and field analysis of the mineralogy, chemistry, and physical properties of the landslide materials and bedrock formations. The investigations provide an understanding of the relative importance of the factors contributing to the origin and reactivation of the landslide. The landslide occurred in overburden resting on the Morrison Formation. Landslide materials consisted of angular fragments of quartzite and sandstone from the Dakota Formation, embedded in very fine-grained to colloidal clayey substances derived mainly from the upper, noncalcareous portion of the Morrison Formation. Remedial measures included excavating a large volume of landslide material and constructing a gravelfill cofferdam on bedrock at the toe of the landslide. (USBR)
W70-02172

THE PARTICLE SIZE SCALE,
Florida State Univ., Tallahassee.
William F. Tanner.
J Sediment Petrology, Vol 39, No 2, p 809-812, June 1969. 4 p, 8 ref.

Descriptors: *Grain sizes, Granular materials, Granules, Gravels, Sands, Silts, Clays, Fines, Sieve analysis, *Size, Scale, Particles, *Particle size, Logarithms, Classification, Geology, Soil science, Civil engineering, Highways, Engineering geology, Soil engineering.
Identifiers: Fineness, Size frequency distribution, Particle diameter.

The Grain Size Study Committee of the Society of Economic Paleontologists and Mineralogists reports the position taken by geologists on particle size scales and nomenclature. The committee recommends the phi scale (negative base 2 logarithm of particle diameter in mm). Advantages of the phi scale are: (1) evenly spaced division points; (2) geometric basis; (3) simple subdivision of spacing to any desired precision; (4) wide range of sizes extending to any extreme; (5) widespread acceptance; (6) approximate coincidence of major dividing points with natural size classifications; (7) ease of use in probability analysis; (8) ease of use in computing statistical parameters; (9) amenable to nonadvanced analytic methods; (10) fairly close approximation to most other scales; and (11) commercially available phi-size screens. No other scale matches this list; most scales do not have more than 3 or 4 of these advantages. Positions taken by engineers and soil scientists of other societies taking part in the project are summarized; the consensus is that too much has been invested in the currently used systems to effect many significant changes. (USBR)
W70-02173

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
For primary bibliographic entry see Field 04D.
W70-02208

SPOIL BANK STABILITY IN EASTERN KENTUCKY,
Forest Service (USDA), Berea, Ky. Northeastern Forest Experiment Station.
Weldon K. Weigle.
Mining Congr J, 52 (4): p 67-73, 1966.

Descriptors: *Strip mines, *Soil mechanics, *Landslides, *Appalachian mountain region, Kentucky, Coal mines, Spoil banks, Soil classifications, Soil strength, Compressive strength, Slope stability.

A survey of contour type strip mining in the mountainous terrain of eastern Kentucky showed 12 percent of spoil outslopes to be in mass failures. This study of spoils at 17 slides in four eastern Kentucky counties showed soil classification variations from sandy silt to clayey silt, a range of 0-10 plastic index, bearing capacity from 1,400 lb. per sq. ft. when dry to almost zero when wet, average densities ranging from 71 to 90 lb. per cu. ft. and a mean unconfined compression of 700 lb. per sq. ft. Stability was computed by Terzaghi's modification of the method of slices based upon a safety factor of unity. A chart relating safe fill bench width to natural slope steepness was presented. The effect of moisture upon spoil stability was recognized. The difference between the measured depth of tension cracks and the depth computed by use of Hcr= 2c/w was held to be due to the spoil not behaving as a truly cohesive material. (Williams-Forest Service)
W70-02210

8E. Rock Mechanics and Geology

GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
Bureau of Reclamation, Sacramento, Calif.
Joe L. Jackson.
Bull Ass Eng Geol, Vol 5, No 2, p 79-99, Fall 1968. 21 p, 4 fig, 2 tab, 11 ref.

Descriptors: Earth dams, Dam foundations, *Foundation investigations, Abutments, *Damsites, *Engineering geology, Geologic investigations, Grout curtains, *Grouting, Riprap, Aggregates, Watertight, Structural geology, Faults (Geology).
Identifiers: Grout take, Arbuckle Dam (Okla), Rock competency.

Arbuckle Dam, a 142-ft-high earthfill dam on Rock Creek near Sulfur, Okla., is on the north flank of the Arbuckle uplift. Complexly folded and faulted Paleozoic shale and limestone in the left abutment and foundation area abut unconformably overlapping Late Pennsylvanian conglomerate in the right abutment. Preconstruction geologic investigations indicated that the foundation was competent and essentially watertight. Because of the geologic complexities at the site, design engineers were apprehensive of the interpretations of the geologists, principally regarding the competence and watertightness of the foundation site. The designers' distrust of the geologists' interpretation resulted in a significant overestimate of the grouting requirement and and a substantially higher grouting cost than would have been required. During construction, the geologic interpretations were found to be essentially correct. Geologic judgment was a challenging but necessary part of preconstruction studies for Arbuckle Dam. The experience points out the value of carefully applied interpretations for the engineer and the engineering geologist. (USBR)
W70-02131

APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
California State Dept. of Water Resources, Sacramento.
G. H. Kruse, K. L. Zerneke, and J. B. Scott.
Prepr, 11th Symp Rock Mech, Berkeley, Calif, June 1969. 32 p, 12 fig, 2 tab, 10 ref.

Descriptors: *Pressure tunnels, *Tunnel design, Tunnels, *Engineering geology, *Tunnel linings, *Steel linings, Rock excavation, Deformation, *Rock mechanics, Rock properties, Joints (Geology), Stress relieving, Underground structures, *Classification, Extensometers, Stress analysis, Faults (Geology), Geologic investigations.
Identifiers: Rock competency, Rock tests, Plate bearing tests, In situ tests, *Deformation modulus, Tehachapi Crossing, Calif.

A rock classification system was developed for determining the in-place deformation modulus of pressure tunnel rock at the A D Edmonstron Pumping Plant Discharge Lines, Calif. The rock classification, based on visual geological examination, gives a numerical rating for rock type, condition of rock, joints, and shear zones. The classification system must be referenced to a suitable program of in situ rock testing and to the design criteria for structural elements requiring support from the rock. The development of the visual classification system, use of the system in conjunction with in situ rock tests and seismic velocity measurements, and an appraisal of the application of the method to pressure tunnel design are discussed. Rock testing included plate bearing tests, borehole stress relief, and measurement of tunnel relaxation as tunnel excavation advanced. Seismic velocity was measured by a portable hammer-type seismic timer instrument. Rock quality according to this system is defined by numerical values that are constant and have the same meaning to geologists and engineers. The classification system provides a refined evaluation of the load-bearing quality of the rock. (USBR)
W70-02145

THE SEISMIC EVENTS AT KOYNA DAM,
California Inst. of Tech., Pasadena.
For primary bibliographic entry see Field 08A.
W70-02146

CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
California Univ., Berkeley; and Utah State Univ., Logan.
H. Bolton Seed, I. M. Idriss, and Fred W. Kiefer.
Proc Amer Soc Civ Eng, J Soil Mech Found Div, Vol 95, No SM5, p 1199-1218, Sept 1969. 20 p, 21 fig, 41 ref, 2 append.

Descriptors: *Earthquakes, *Motion, *Earth movements, *Rocks, *Seismology, Earthquake Engineering, Frequency, Accelerating, Geologic formations, Evaluation, Faults (Geology), Rock mechanics, Soil mechanics, Attenuation, Damping, Bibliographies, Seismic studies, Seismographs.
Identifiers: *Magnitude, Shakers, Acceleration (Mechanical), Eqicenters, Dynamic response, Acceleration pattern, El Centro, Calif.

Procedures are given for evaluating probable motion characteristics of rock formations during earthquakes. Rock motions are characterized in terms of maximum amplitude of accelerations, predominant period of motions, and duration of motions. The characteristics depend mainly on the magnitude of the earthquake and distance of the site from the zone of energy release. Available data relating rock motion characteristics to the magnitude of the earthquake and the distance to the causative fault are used to establish a general procedure for assessing the maximum acceleration, predominant period, duration of shaking, and time history of accelerations developed during any given earthquake. As an example, rock motions at the El Centro, Calif site (1940 El Centro earthquake) are estimated using the proposed procedure and incorporated in analyses of the response of the site. Computed surface motions agree with those recorded during the 1940 El Centro earthquake. (USBR)
W70-02159

THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
Imperial College of Science and Technology, London, (England).
P. G. Rookes, and J. L. Knill.
Eng Geol Int J, Vol 3, No 2, p 81-120, Apr 1969. 40 p, 33 fig, 4 tab, 14 ref.

Descriptors: *Engineering geology, Foreign construction, Mountains, Foreign projects, *Deserts, Arid climates, *Arid lands, Reservoir sites, Dam foundations, Semiarid climates, Semiarid land, Reservoirs, Reservoir silting, Dams, Tunneling, Earthquakes, Road construction, Construction materials, Groundwater, Groundwater geology, *Geologic investigations.

Identifiers: Iran, Engineering works, Earthquake damage.

Engineering geology plays a useful part in planning and executing engineering developments in arid countries. The engineering geologist forms a part of a team contributing to the identification and solution of engineering problems. The application of engineering geology to regional development of semiarid and arid areas in Iran is discussed. The geology of Iran is outlined; engineering problems encountered under varied geologic conditions in mountain ranges and in different zones of wide desert plains are discussed. Examples demonstrate the application of engineering geology for reservoir construction, reservoir silting, tunneling, earthquake investigations, road construction, selection of materials, and groundwater development. Contributions of the engineering geologist to engineering development are probably more important in arid regions than in most other climatic zones. (USBR)
W70-02162

FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
I. A. Pecherkin.
Hydrotech Constr, No 12, p 1060-1063, Dec 1968. 4 p, 3 fig, 1 tab, 1 ref.

Descriptors: *Reservoirs, *Shores, *Solubility, *Gypsum, *Karst, Rock properties, Reservoir surveys, Anhydrite, Calcium sulfate, Deterioration, Foreign research, Geologic investigations, Engineering geology.
Identifiers: *Rock dissolution, *Shore reformation, Kama Reservoir, USSR/USSR, Shoreline development, Soluble rocks, Solution rate.

The shores of reservoirs on karstic sulfate rock are continually being destroyed with unabating intensity. Rocks directly at the waterline are dissolved, niches are formed, blocks cave in, and the caved rock is dissolved. As the exposed rock comes into contact with the waves, conditions are readied for renewed caving. The solution of gypsum also occurs below the water surface. Destruction of karstic shores is fundamentally different than reworking nonkarstic sand and gravel shores; reworking nonkarstic shores abates gradually as shores develop and the inshore shoal is formed. The destruction of karstic shores is caused by solution of the rock; shoals are not formed and the shore remains deep, maintaining the rate of rock dissolution. Observations of shore destruction at Kama Reservoir, USSR, show a linear rate for shore recession over many years, with periods of rest and active shore retreat. Equations are given for predicting the rate of shore retreat and for calculating the volume of caved and, subsequently, dissolved rock. Calculations of the volume of caved rock and the rate of rock dissolution can give approximations of the periods of rest and destruction. (USBR)
W70-02166

GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
Building Research Station, Watford (England); and Institute of Geological Sciences, London (England).
W. H. Ward, J. B. Burland, and R. W. Gallois.
Bldg Res Sta Curr Pap, CP 3/69, p 399-431, Mar 1969. 37 p, 30 fig, 6 tab, 3 ref, 2 append.

Descriptors: *Sites, Rock properties, *Rock foundations, Tunnels, Rock mechanics, *Chalks, Underground structures, Subsurface investigations, Engineering geology, Geologic investigations, Deformation, *Field tests, Auger borings, *Foundation investigations, Foundation rocks, Field investigations.
Identifiers: *In situ tests, Rock tests, Underground openings, In situ rock, Foreign testing, Great Britain, Loading tests, Plate load tests.

A proposed site for a 300-GeV proton accelerator at Munford, England, was evaluated and shown to be geotechnically acceptable. The large accelerator has very stringent requirements for ground stability and deformation under load that are foreign to normal civil engineering experience and practice. The investigation represents a new approach to the evaluation of a large site on soft rock; the method is based on large-scale field work, without recourse to laboratory testing that often proves unsatisfactory. The rock (chalk) was classified into 5 grades according to features likely to influence load deformation behavior. The rock was described in situ by visual examination in man-sized auger holes. Load deformation was measured directly in the field by full-scale water tank loading tests and by plate loading tests. Field investigation procedures and results are discussed. (USBR)
W70-02170

8F. Concrete

FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
Bureau of Reclamation, Denver, Colo.
For primary bibliographic entry see Field 08G.
W70-02137

SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
Portland Cement Association, San Francisco, Calif. Western Region.
E. H. Rogers.
US Department of Agriculture, Agricultural Research Service, ARS-41-147, p 94-105, Apr 1969. 12 p, 2 fig, 5 photo, 1 tab, 8 ref.

Descriptors: *Soil cement, *Linings, Leakage, Reservoir leakage, Seepage.

Soil-cement has been used successfully as a low-cost lining material for water-containing structures for over 20 years. The more important applications include linings for domestic water supply reservoirs, farm irrigation ponds, sewage lagoons, and manmade lakes. Soil-cement is not intended to replace concrete, which remains the material best suited for permanent linings. But, for the many structures for which a concrete lining is not economically feasible, perhaps becuase of a short design life or inadequate financing, a soil-cement lining can provide an economical solution. The engineering technology of soil-cement is well understood today as a result of extensive research and wide application in road construction extending over a period of more than 30 years. Physical and chemical properties of soil-cement are predictable and controllable with the application of well-defined engineering techniques. A wide variety of construction equipment is available to mix and place soil-cement for both small and large projects. Procedures for soil-cement construction are uncomplicated and as easily adapted for the construction of lining for a small farm reservoir as to that for a multimillion-gallon-capacity reservoir.
W70-02281

8G. Materials

FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
Bureau of Reclamation, Denver, Colo.
H. Johns.
Bur Reclam Rep No ChE-67, June 1969. 63 p, 22 fig, 9 tab, 2 ref, append.

Descriptors: *Sealing compounds, *Joints, *Contraction joints, *Joint fillers, Plastics, Concretes, Adhesion, Mastics, Erosion, Canal linings, Durability, Cohesion, Consistency, Abrasive blasting, Elastomers, Idaho, Specifications, *Sealants, Field investigations, Field tests, *Cracks, Sun.
Identifiers: New York Canal (Idaho), Deaver Canal (Wyo), Canal sealants, St. Vrain Supply Canal (Colo), Product evaluation.

Field tests of sealing materials for random cracks and contraction joints in 3 concrete-lined canals are reviewed. Exposure periods vary from 2 to 10 yr.; environments vary from a mild northern climate to a severe northern climate. Tests indicate that: (1) coal tar extended polysulfide sealants conforming to Bureau of Reclamation canal sealant specifications and the glass cloth reinforced asphalt mastic tape should provide a durable seal for random cracks; (2) the polysulfide sealant should provide durable sealing for contraction joints; (3) the rubberized asphalt mastic will be durable only if protected from the weather and if applied in a deep section; (4) application conditions are less critical for asphalt sealers than for synthetic rubber materials; and (5) the shape factor is a lesser consideration in joint sealers than in crack sealers. (USBR)
W70-02137

COMPARISON TESTS OF STEEL PIPE COATINGS,
East Bay Municipal Utility District, Oakland, Calif.
Lee B. Hertzberg, and Arne E. Westerback.
J Amer Water Works Ass, Vol 61, No 7, p 343-346, July 1969. 4 p, 1 fig, 2 tab, 7 ref.

Descriptors: *Steel pipes, *Protective coatings, *Corrosion control, Corrosion, Field tests, Coatings, Laboratory tests, Polyethylenes, Pipelines, *Cathodic protection.
Identifiers: *Corrosion tests, Pipe wrappings, Underground corrosion, Test results, Buried pipes, Corrosion currents.

Tests of steel pipe coatings are used primarily to predict performance in protecting the steel pipe from deterioration. Laboratory tests give a limited indication of coating performance, depending on how accurately the tests reflect field conditions. Field tests are not completely satisfactory; some doubt exists that the examined portion of pipe is representative. Frequently results are based on subjective judgment, and conclusive evaluation requires too many years, considering the rapid developments in the pipe coating industry. An ideal test should provide, in a reasonably short time and at no great cost, numerical results on coating performance and condition of coating. An ideal test procedure is proposed for coated pipe in the field, provided that the coated pipe is placed under cathodic protection at installation and that the electrical resistance of the coating is so high that soil resistance is negligible. This test is based on the assumption that the cathodic current required to maintain a pipe-to-soil potential of minus 850 mv, referenced to a copper-copper sulfate electrode, is directly proportional to coating deterioration. (USBR)
W70-02140

COOLING WATER CHEMICAL TREATMENTS,
Betz Labs., Inc., Trevose, Pa. Cooling Water Services.
For primary bibliographic entry see Field 05D.
W70-02294

09. MANPOWER, GRANTS AND FACILITIES

9B. Education (In-House)

MOTIVATION OF SCIENTISTS AND ENGINEERS,
Arizona Univ., Tucson.
George W. Howard.
Proc Inst Environ Sci 1969 Annu Tech Meet, Anaheim, Calif, p 584-588, Apr 1969. 5 p, 6 ref.

Descriptors: *Motivation, Management, *Engineering personnel, Research and development, *Scientific personnel, Inventions, Creativity, Employee relations, *Working conditions, Profit, Salaries, Public benefits, Human behavior, Leadership, Human engineering, Standards, Technical societies, Applied psychology, Communication, Training, Behavior (Psychology).
Identifiers: *Psychological climate, Professional advancement, Goals, Recognition, Problem solving.

Motivating an individual scientist or engineer in this day of team approach and large bureaucratic organizations requires careful placement of the individual, high standards for his performance, open channels of communications, and opportunities for career advancement. Of 22 motivating forces listed, fear was least important because of the ascendency of security in our modern society. A climate must be carefully cultivated by management to motivate an individual to optimum achievement in creativity, to encourage group cooperative effort, and to free him from noncreative work. Industry, Government, and universities are striving to permit mature individuals to make their greatest possible contributions. Research establishments in these institutions have many common problems. Management must provide guidance and friendly helpfulness to maintain the best for the professional man. A sense of urgency and public good in working on an important problem, recognition of his peers, professional advancement, opportunities for advanced training and participation in technical societies, and a sense of personal accomplishment all contribute to a highly suitable climate where an individual can develop his full capabilities. (USBR)
W70-02148

9C. Research Facilities

DESALINATION RESEARCH AT OAK RIDGE,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 03A.
W70-02117

9D. Grants, Contracts, and Research Act Allotments

REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.

Ronald R Renne, Chairman. Proc 4th Annu Water Resources Res Conf, Wash, DC, Jan 28-29, 1969. 162 p, 2 append.

Descriptors: *Water resources research act, *Water resources development, *Conferences, *Reviews, Grants, Legislation, Legal aspects, Social aspects, Laboratories, Research facilities, Governments, Planning, Projects, Research and development.
Identifiers: *Water resources research, OWRR, WRSIC.

Papers and discussions of the 4th Annual Water Resources Research Conference, January 28-29, 1969, Washington, D.C., are presented. The meeting was planned by a representative group of water resources research institute and center directors and the staff of OWRR. The conference focused primarily on updating the 10-year water resources research program and the transfer of research results. In addition to prepared papers relating to the main conference theme, papers were also presented on multidisciplinary research and on the panel report of the Office of Science and Technology on policy and institutions in water resources research. These presentations were followed by general discussion led by discussion panels. Other highlights of the meeting included a talk on the prospects of additional legislation dealing with water resources research, a report on the activities of the Water Resources Scientific Information Center, and brief reports by representatives of six geographical regions and regional research activities followed by general discussion. (Knapp-USGS)
W70-02043

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
Federal Water Pollution Control Administration, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-02285

10. SCIENTIFIC AND TECHNICAL INFORMATION

DESALINATION RESEARCH AT OAK RIDGE,
Oak Ridge National Lab., Tenn.
For primary bibliographic entry see Field 03A.
W70-02117

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I and II,
Texas A and M Univ., College Station.
John B. Herbich, E. B. Smith, and J. D. Benson.
Available from the Clearinghouse as PB-188 290, $3.00 in paper copy, $0.65 in microfiche. Texas Water Resources Institute, Texas A and M University, Technical Report No 23 Vol I, Nov 1969. 154 p, 3 append. OWRR Project W-103.

Descriptors: *Information Retrieval, Abstracts, Data Storage and Retrieval, Value, *Documentation.
Identifiers: *Information Services, *Information Dissemination.

FIELD EVALUATION OF POTENTIAL WRSIC USERS: A field evaluation study of user requirements for effective use of the Water Resources Scientific Information Center (WRSIC) is described. The study was made up of several components including an analysis of potential users classified by their participation in various aspects of water resources; determination of WRSIC user needs according to the type of user; determination of the cost user may pay for services and quality of service demanded; kinds of information that should be included in WRSIC; type of service requirements of potential users; and potential input to WRSIC by users. Total number of organizations interviewed by mail and by personal visits was 726 and total number of persons interviewed was 128. Mail Questionnaire was sent to 669 participants and the response was 52.9 percent. The results of the study are summarized in the graphical and tabular form. Volume II contains supplementary data for Volume I. Volume III reports on a study to assess the cost effectiveness of WRSIC services.
W70-02235

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
Texas A and M Univ., College Station. Water Resources Inst.
Eugene B. Smith, John B. Herbich and James D. Benson.
Available from the Clearinghouse as PB-188 291, $3.00 in paper copy, $0.65 in microfiche. Texas Water Resources Institute, Research Project Completion Report, Volume II, Technical Report No. 23, Nov 1969. 179 p, 2 append. OWRR Project W-103.

Descriptors: *Information retrieval, *Documentation, Abstracts, Data storage and retrieval, Value.
Identifiers: *Information Services, *Information dissemination.
Supplementary information and supporting data for the main report (Volume I) is presented in this second volume. All questionnaire forms and related material, as well as a complete report of the case study phase are included in Appendix I. Other appendices contain detailed listings of the narrative responses received for questions on the questionnaires. Tables which present a variety of statistical data pertinent to the study are also included.
W70-02236

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
Texas A and M Univ., College Station.
E. B. Smith, J. B. Herbich, and J. D. Benson.
Available from the Clearinghouse as PB-188 292, $3.00 in paper copy, $0.65 in microfiche. Texas Water Resources Institute, Research Project Completion Report, Texas A and M Univ, Volume III. Technical Report No 23, Nov 1969. 36 p, 2 append. OWRR Project W-103.

Descriptors: *Information Retrieval, Abstracts, Data Storage and Retrieval, Value, *Documentation.
Identifiers: *Information Systems, *Information Dissemination.

STUDY OF THE WRSIC SDI AND SWRA INFORMATION SERVICES: A study designed to analyze two information services provided by the Water Resources Scientific Information Center is described. The study was conducted to assess the monetary value and acceptability to users of the Selected Water Resources Abstracts Journal (SWRA) and the Selective Dissemination of Information (SDI) System. The results indicate that WRSIC is providing a useful and valuable service to those users who are active in the area of water resources. Comments received from the participants should provide information which will be of assistance in improving future services. This is the second of two studies conducted simultaneously and is presented in Volume III of the final project report.
W70-02237

BIBLIOGRAPHY ON THERMAL POLLUTION.
American Society of Civil Engineers, New York. Committee on Thermal Pollution.
For primary bibliographic entry see Field 05B.
W70-02410

SUBJECT INDEX

ABSTRACTS
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

ACCELERATED EROSION
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

ACCESS ROUTES
MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

ACETIC ACID
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

ACETYLCHOLINESTERASE ACTIVITY
SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

ACIDIC SPOILS
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

ACIDIC WATER
ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

ACIDITY
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

ACTIVATED SLUDGE
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A STUDY OF AERATED LAGOON, ACTIVATED SLUDGE AND ACTIVATED SLUDGE WITH SLUDGE REAERATION IN THE TREATMENT OF FRUIT CANNERY WASTE,
W70-02284 05D

ADAPTATION
FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
W70-02368 05C

ADMINISTRATIVE AGENCIES
INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
W70-02135 06E

ADSORPTION
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

AERATION
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

SURFACE AERATION,
W70-02296 05G

AERIAL PHOTOGRAPHY
AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
W70-02066 07C

AEROBIC TREATMENT
AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A STUDY OF AERATED LAGOON, ACTIVATED SLUDGE AND ACTIVATED SLUDGE WITH SLUDGE REAERATION IN THE TREATMENT OF FRUIT CANNERY WASTE,
W70-02284 05D

AGITATION
SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

AGRICULTURAL ENGINEERING
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

AGRICULTURAL WATERSHEDS
RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

ALASKA
FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
W70-02089 04A

OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
W70-02178 05D

SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
W70-02312 04A

ALGAE
EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

TRISODIUM NITRILOTRIACETATE AND ALGAE,
W70-02248 05C

DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
W70-02249 05C

ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

ALGAE TOXICITY
EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

ALGAL GROWTH
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

ALGAL PRODUCTION
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

ALGICIDES
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

ALKALINE SOILS
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

ALKALINITY
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

ALLUVIAL CHANNELS
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
W70-02070 08B

LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

ALTERNATING CURRENT
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

ANAEROBIC DIGESTION
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

ANALOG COMPUTERS
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

ANALOG MODELS
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA, W70-02288 02F

ANALYTICAL ECONOMICS
LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS, W70-02390 06A

ANALYTICAL TECHNIQUES
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY, W70-02099 02K

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN), W70-02232 02D

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE, W70-02265 06A

LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS, W70-02316 02J

ANION EXCHANGE
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY, W70-02099 02K

ANNELIDS
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION, W70-02360 05C

ANNUAL ACTIVATED SLUDGE
WASTEWATER TREATMENT, W70-02196 05D

ANTAGONISTIC ACTION
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS, W70-02249 05C

ANTARCTIC
SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS, W70-02437 02C

ANTECEDENT MOISTURE
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA, W70-02083 02G

ANTECEDENT PRECIPITATION
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA, W70-02083 02G

ANTHRACITE
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE, W70-02212 04A

ANTIBIOTIC TOXICITY
THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN), W70-02366 05C

APPALACHIAN MOUNTAIN REGION
SPOIL BANK STABILITY IN EASTERN KENTUCKY, W70-02210 08D

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION, W70-02214 04A

EROSION FROM ABANDONED COAL-HAUL ROADS, W70-02215 04D

AQUATIC MACROPHYTES
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS, W70-02249 05C

AQUATIC PLANTS
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS, W70-02249 05C

AQUEOUS SOLUTIONS
THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS, W70-02292 02K

AQUIFERS
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO, W70-02076 03B

OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY, W70-02077 03B

CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING, W70-02079 07B

EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA, W70-02081 03B

SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA, W70-02094 02L

GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY, W70-02305 02F

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA, W70-02309 02F

ARABIAN PENINSULA
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY, W70-02423 02G

ARABLE LANDS
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY, W70-02423 02G

ARCTIC
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE, W70-02178 05D

PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS, W70-02183 05D

ARID CLIMATES
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH, W70-02435 03F

ARID LANDS
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN, W70-02162 08E

THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS, W70-02420 06B

THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY, W70-02423 02G

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA, W70-02424 03C

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS, W70-02425 02G

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS, W70-02430 02G

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER, W70-02432 05G

SALTING IN IRRIGATION AREAS, W70-02433 02G

SALINIZATION OF SOILS OF PIEDMONT PLAINS, W70-02434 02G

DON'T STRESS YOUR WHEAT FOR WATER, W70-02436 03F

ARIZONA
DON'T STRESS YOUR WHEAT FOR WATER, W70-02436 03F

ARKANSAS
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS, W70-02055 03B

ARKANSAS RIVER
CANAL SHOALING STUDIES, W70-02108 08B

ARTIFICIAL RECHARGE
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN, W70-02154 04B

ARTIFICIAL WATERCOURSES
CANALS AND POOLS. W70-02127 06E

ATHER-EL-NABI CHANNEL
MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL. W70-02109 08B

ATLANTIC OCEAN
MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY, W70-02302 02K

ATTITUDE MEASUREMENT
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE, W70-02279 06B

ATTITUDES
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,

W70-02278 06B

INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

AUSTRALIA
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
W70-02425 02G

PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

SALTING IN IRRIGATION AREAS,
W70-02433 02G

WATER REPELLENT SANDS,
W70-02440 02G

AUTECOLOGY
AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
W70-02247 02H

AVAILABLE SOIL WATER CAPACITY
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

BACKWASH
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

BACTERIA
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

BACTERIAL MOBILITY
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

BACTERIAL RESPIRATION
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

BACTERIAL SURVIVAL
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

BACTERICIDES
BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

BAFFLES
A COOLING POND PROVES CHEAPER,
W70-02409 05D

BAYS
FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

BEACH LAMINATIONS
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

BEACHES
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
W70-02290 03A

SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

BED LOAD
A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
W70-02103 08B

PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

CANAL SHOALING STUDIES,
W70-02108 08B

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

BED MOVEMENTS
MECHANICS OF BED FORMATIONS,
W70-02149 08B

BED RESISTANCE
MECHANICS OF BED FORMATIONS,
W70-02149 08B

BED RIPPLES
MECHANICS OF BED FORMATIONS,
W70-02149 08B

BEHAVIORAL MEASUREMENT
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

BENDING MOMENTS
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

BENTHIC FAUNA
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

BENTHOS
THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
W70-02366 05C

BIBLIOGRAPHIES
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

HYDROLOGY ANNUAL NO. 14 - 1966.
W70-02307 02E

BIBLIOGRAPHY ON THERMAL POLLUTION.
W70-02410 05B

BIOASSAY
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

CHRONIT ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHIORELLA PYRENOIDOSA,
W70-02370 05C

BIOASSAYS
A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

BIOCHEMICAL OXYGEN DEMAND
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

BIODEGRADATION
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

BIOINDICATORS
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
W70-02360 05C

BIOLOGICAL PROPERTIES
HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
W70-02404 02H

BIOLOGICAL TREATMENT
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

BIOLOGY
PESTICIDES,
W70-02132 05G

BIOMASS
ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

BIRD EGGS
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

BOGS
ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

BOILERS
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

BONDS
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

BORON
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

BRINES
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

BROMINE
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

BROOK TROUT
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

BURNING
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

BUTYL ACETATE
INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

BUTYRIC ACID
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

BYPASSES
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. E. HATFIELD, AND A. WHINSTON,
W70-02257 05G

BYPRODUCTS
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

CALIBRATIONS
EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
W70-02102 07B

CALIFORNIA
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
W70-02085 04A

FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
W70-02086 04A

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
W70-02087 04A

CANADA
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

CANALS
SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
W70-02109 08B

CANALS AND POOLS.
W70-02127 06E

CAPITAL
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

CARBONATE ROCKS
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (FLAT), RED SEA,
W70-02337 02L

CARBONATES
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

CATHODIC PROTECTION
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

CATION EXCHANGE
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

CATIONS
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

CELLULOSE
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

CENTRIFUGATION
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

CENTRIFUGES REDUCE WATER POLLUTION,
W70-02295 05G

CEREBELLUM
THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
W70-02361 05C

CHALKS
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

CHANNEL IMPROVEMENT
CANAL SHOALING STUDIES,
W70-02108 08B

CHANNEL MORPHOLOGY
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

CHANNELING
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

CHANNELS
PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

WATERWAY INDUSTRIAL SITES A CHICAGO CASE STUDY,
W70-02386 06B

CHARTS
CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

CHELATION
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

CHEMICAL OXYGEN DEMAND
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

CHEMICAL REACTIONS
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

CHICAGO
WATERWAY INDUSTRIAL SITES A CHICAGO CASE STUDY,
W70-02386 06B

CHLORELLA
ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

CHLORINATED HYDROCARBON PESTICIDES
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
W70-02345 05C

CHLORINATION
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

CHLOROPHYTA
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

CHUTES
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

CLADOPHORA
EFFECT OF HALOGENS ON ALGAE - II. CLADOPHORA SP.,
W70-02364 05C

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

CLARK COUNTY(ARK)
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

CLASSIFICATION
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

CLAY MINERALOGY
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

CLAY MINERALS
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

CLAYS
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

CLIMATES
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

CLIMATIC DATA
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

CLIMATIC ZONES
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

CLOSED CONDUIT FLOW
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

CLOUD SEEDING
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

COAGULATION
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

COAL MINE WASTES
ABANDONED MINES.
W70-02163 05G

RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

COAL MINES
CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
W70-02128 06E

COATINGS
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

COKE WASTES
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

COLD REGIONS
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

COLD WEATHER CONSTRUCTION
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

COLOR REMOVAL
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

COLUMBIA RIVER BASIN
THERMAL MODIFICATION OF RIVER WATER QUALITY,
W70-02408 07C

COLVILLE RIVER BASIN(WASH)
CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
W70-02060 02E

COMBINED SEWERS
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

COMBINED WASTES
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

COMMERCIAL SHELLFISH
SHELLFISH GROUNDS AND PACKING HOUSES.
W70-02268 06E

COMMUNITY RESPIRATION
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

COMPACTED SOILS
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

COMPACTION
COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

COMPUTER MODELS
A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

COMPUTER PROGRAMS
A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
W70-02103 08B

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

CONDENSATION
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

CONE VALVES
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

CONFERENCES
REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
W70-02043 09D

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

CONFIGURATION
MECHANICS OF BED FORMATIONS,
W70-02149 08B

CONNECTICUT
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

CONSOLIDATION
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

CONSTRUCTION
CONSERVATION IN A NEW TOWN,
W70-02329 02J

CONSTRUCTION COSTS
REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

CONSTRUCTION DETAILS
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

CONSTRUCTION GRANTS PROGRAM
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

CONSTRUCTION MATERIALS
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

CONSUMPTIVE USE
WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

CONTACT TIME
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

CONTRACTION JOINTS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

CONVECTION
SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

COOLING
DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
W70-02414 05B

COOLING POND
A COOLING POND PROVES CHEAPER,
W70-02409 05D

COOLING SYSTEMS
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

COOLING TOWER
A COOLING POND PROVES CHEAPER,
W70-02409 05D

COOLING TOWERS
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

COOLING WATER
COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

CORROSION
COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

CORROSION CONTROL
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

CORROSION TESTS
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

COST ANALYSIS
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

COST COMPARISONS
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

A COOLING POND PROVES CHEAPER,
W70-02409 05D

COSTS
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

COST-BENEFIT ANALYSIS
TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

COVER CROPS
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

CRACKS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

CRAYFISH
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

CROSSFLOW-FILTRATION
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

CURRENTS(WATER)
MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

CYANOPHYTA
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

CYCLICAL GROWTH
THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

CYCLING
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

DADE COUNTY(FLA)
HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

DAIRY INDUSTRY
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

DAMS
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

DAMSITES
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
W70-02131 08E

DAPHNIA
THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
W70-02366 05C

INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),

W70-02367 05C

FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
W70-02368 05C

DATA COLLECTIONS
WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W7C-02097 02J

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
W70-02114 07C

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
W70-02115 07C

WATER RESOURCE OBSERVATORY SOLAR RADIATION DATA-WATER YEAR 1969 AND PRIOR.
W70-02242 07C

CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

HYDROLOGY ANNUAL NO. 14 - 1966.
W70-02307 02E

BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
W70-02317 02F

HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

DATA PROCESSING
CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

DATA TRANSMISSION
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

DATING
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

DECISION MAKING
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

DEFORMATION MODULUS
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

DEGRADATION
DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
W70-02341 05C

IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

DELAWARE RIVER
WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

DELTAS
FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

DEMAND VARIABILITY
A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

DEMINERALIZATION
EVAPORATION FOR DESALINATION,
W70-02158 03A

DEMONSTRATION WATERSHEDS
DECADE REPRESENTATIVE AND EXPERIMENTAL RESEARCH BASINS IN THE UNITED STATES.
W70-02064 07A

DENDROCHRONOLOGY
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

DEPARTMENT OF AGRICULTURE
PESTICIDES,
W70-02132 05G

DEPOSITION(SEDIMENTS)
SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965,
W70-02262 02J

DESALINATION
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

EVAPORATION FOR DESALINATION,
W70-02158 03A

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

DESALINATION PLANTS
FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
W70-02290 03A

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

DESALINATION PROCESSES
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS,
W70-02063 03A

EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

DESERT SALTBUSH
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

DESERTS
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

DESIGN
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

DESIGN CRITERIA
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

DESIGN DATA
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

DESIGN STORM
DESIGN STORM DETERMINATION IN SOUTH AFRICA,

DES-DYN
W70-02324 02B

DEWATERING
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

DIAGENESIS
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

DIBUTOX
INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

DICHLOBENILS
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

DIFFUSER EFFICIENCY
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

DIFFUSERS
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

DIFFUSION
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

DIGITAL COMPUTERS
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

DIKES
A COOLING POND PROVES CHEAPER,
W70-02409 05D

DIRECT CURRENT
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

DISCHARGE MEASUREMENT
PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

DISCHARGE(WATER)
DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
W70-02225 02A

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

DISINFECTION
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

DISPERSANTS
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

DISPERSION
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

DISPOSAL
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

DISSOLVED OXYGEN
A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

DISTILLATION
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

DITCHES
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
W70-02178 05D

DIVERSION
FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

DOCUMENTATION
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

DOPPLER RADAR
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

DOSAGE
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

DRAFT TUBES
EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
W70-02157 08C

DRAINAGE
SALTING IN IRRIGATION AREAS,
W70-02433 02G

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

DRAINAGE SYSTEMS
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
W70-02425 02G

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

DROUGHTS
WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

DUNES
SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

DURATION CURVES
DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

DYE ADSORPTION
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

DYE RELEASES
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

DYNAMIC PROGRAMMING
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

EARTH DAMS
CONTROL OF SEEPAGE IN EARTH DAMS,
W70-02164 04A

EARTH MOVEMENTS
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

EARTHQUAKE ENGINEERING
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

EARTHQUAKES
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

EARTHWORKS
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

ECONOMIC DATA
THE STATE OF ECONOMIC DATA,
W70-02378 06B

ECONOMIC EFFICIENCY
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

THE INVESTMENT DECISION FOR SEEPAGE REDUCTION,
W70-02156 06C

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

ECONOMIC FEASIBILITY
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

ECONOMICS
WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

ECONOMICS OF WATERSHED PLANNING.
W70-02374 06B

WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

ECONOMIES OF SCALE
TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

ELASTOMERS
CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

ELECTRIC POWER GENERATION
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

ELECTRICAL STABILITY
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

ELECTRODES
ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

ELECTROENCEPHALOGRAPH PATTERNS
THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
W70-02361 05C

ELEMENTS(CHEMICAL)
THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

ENDRIN
MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
W70-02347 05C

ENERGY BUDGET
INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
W70-02414 05B

ENERGY LOSSES
LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

ENGINEERING GEOLOGY
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
W70-02131 08E

APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

ENGINEERING PERSONNEL
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

ENGINEERING STRUCTURES
SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

ENVIRONMENTAL EFFECTS
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

EQUATIONS
AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

EROSION
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

CANAL SHOALING STUDIES,
W70-02108 08B

ROADSIDE EROSION SURVEY,
W70-02327 02J

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

EROSION CONTROL
CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

ROADSIDE EROSION SURVEY,
W70-02327 02J

CONSERVATION IN A NEW TOWN,
W70-02329 02J

ESTIMATING
EVALUATION OF ERRORS PRESENT IN WATER BALANCE INVESTIGATIONS (RUSSIAN),
W70-02218 02A

ESTUARIES
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

EUTROPHICATION
THE OVERALL PICTURE OF EUTROPHICATION,
W70-02251 05C

EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
W70-02254 02H

FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS

AND OTHER WATERS,
W70-02304 05C

EVAPORATION
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

EVAPORATION FOR DESALINATION,
W70-02158 03A

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

EVAPORATION CONTROL
INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

EVAPORATIVE COOLING
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

EVAPOTRANSPIRATION
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

EXCAVATION
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

EXCHANGEABLE SODIUM PERCENTAGE
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

EXPERIMENTAL WATERSHEDS
DECADE REPRESENTATIVE AND EXPERIMENTAL RESEARCH BASINS IN THE UNITED STATES.
W70-02064 07A

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

EXTRA HIGH VOLTAGE
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

FAIRBANKS(ALAS)
FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
W70-02089 04A

FARM WASTES
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

FEASIBILITY
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

FEDERAL GOVERNMENT
CONGRESS AND WATER RESOURCES,
W70-02160 06E

FEDERAL JURISDICTION
CITIZENS COMMITTEE FOR THE HUDSON VALLEY V VOLPE (CONSTRUCTION PERMITS WITHOUT APPROVAL AS REQUIRED BY THE RIVERS AND HARBORS ACT OF 1899).
W70-02061 06E

BOUNDARIES, JURISDICTION AND EMBLEMS.
W70-02150 06E

FERMENTATION
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

FESCUES
TREE SURVIVAL AND GROWTH ON FESCUE COVERED SPOIL BANKS,
W70-02211 04A

FIELD TESTS
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

FINANCIAL FEASIBILITY
RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

FINANCING
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

FINE AGGREGATES
THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

FISH
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

FISH HARVEST
FISH-LIFE AND POLLUTION IN THE LOWER THAMES A REVIEW AND PRELIMINARY REPORT,
W70-02356 05C

FISH HISTOPATHOLOGY
CHRONIT ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

FISH POPULATIONS
EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS,
W70-02351 05C

FISH SURVIVAL
CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH INCREASED SILT,
W70-02348 05C

FISHKILL
MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
W70-02347 05C

FLOOD DAMAGE
FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
W70-02085 04A

FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
W70-02086 04A

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
W70-02087 04A

FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
W70-02088 04A

FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
W70-02089 04A

FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
W70-02312 04A

FLOOD FORECASTING
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

FLOODS
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
W70-02085 04A

FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
W70-02086 04A

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
W70-02087 04A

FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
W70-02088 04A

FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
W70-02089 04A

SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
W70-02121 02E

FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
W70-02122 02E

FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
W70-02123 02E

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
W70-02312 04A

FLORIDA
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

FLOW LOSS
LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

FLOW MEASUREMENT
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

FLOW RESISTANCE
MECHANICS OF BED FORMATIONS,
W70-02149 08B

FLOW SEPARATION
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

FOOD CHAINS
INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

FOOTINGS
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

FOREST SOILS
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

FORMOL
THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

FOUNDATION INVESTIGATIONS
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
W70-02131 08E

GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

FOUNDATIONS
COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

FREEZING
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

GASES
INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

GASKETS
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
W70-02133 08A

GEOCHEMISTRY
GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

GEOLOGIC INVESTIGATIONS
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

GEOLOGY
GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

GEOMORPHOLOGY
MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

GERMINATION
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

GLACIAL DRIFT
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

GLACIAL SOILS
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

GLACIERS
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

GOLODNAYA STEPPE
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

GOVERNMENT
A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

GRAIN SIZES
THE PARTICLE SIZE SCALE,
W70-02173 08D

GRASSES
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

GROSS AID PLAN
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

GROUNDWATER
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

SALTING IN IRRIGATION AREAS,
W70-02433 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

GROUNDWATER MOVEMENT
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

GROUNDWATER RECHARGE
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUNDWATER-LEVEL CONDITIONS,
W70-02263 04B

DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

GROUTING
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
W70-02131 08E

COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

GROWTH RATES
ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

GUAYAMA
POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

GULF OF AQABA
GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

GULLY EROSION
EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

GYPSUM
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

HALOGENS
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

EFFECT OF HALOGEN ON ALGAE - II. CLADOPHORA SP.,
W70-02364 05C

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

HATCHING
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

HAWAII
PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

HEAD TANKS
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

HEAT
THERMAL MODIFICATION OF RIVER WATER QUALITY,
W70-02408 07C

HEAT TRANSFER
A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

HEAT AND MASS TRANSFER BETWEEN A WATER SURFACE AND THE ATMOSPHERE.
W70-02401 02D

DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
W70-02414 05B

HERBICIDES
PESTICIDES,
W70-02132 05G

HIGHWAY ENGINEERING
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

HIGHWAYS
ROADSIDE EROSION SURVEY,
W70-02327 02J

HIGH-TOXICITY EFFLUENTS
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

HISTOPATHOLOGY
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

HOT STRIP MILL
STEEL COMPANY BUILDS FLEXIBLE WASTEWATER TREATMENT SYSTEM,
W70-02176 05D

HOWELL-BUNGER VALVES
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

HYDRAULIC DESIGN
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

HYDRAULIC EQUIVALENCE(SETTLING RATE)
HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE ENTRAINMENT PROCESS,
W70-02074 02J

HYDRAULIC MACHINERY
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

HYDRAULIC MODELS
TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

HYDRAULIC TURBINES
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
W70-02157 08C

HYDROGEOLOGY
GEOHIDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

HYDROGRAPH ANALYSIS
CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

HYDROGRAPHS
CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

HYDROLOGIC ASPECTS
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

HYDROLOGIC BUDGET
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

HYDROLOGIC CLASSIFICATION
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

HYDROLOGIC DATA
HYDROLOGY ANNUAL NO. 14 - 1966.
W70-02307 02E

BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
W70-02317 02F

HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

HYDROLOGIC PROPERTIES

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

HYPERFILTRATION
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

IDAHO
INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

ILLINOIS
GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

IMPERVIOUS MEMBRANES
A NEW METHOD OF INSTALLING PLASTIC MEMBRANES,
W70-02274 04A

IMPERVIOUS SOILS
WATER REPELLENT SANDS,
W70-02440 02G

IMPOUNDMENTS
HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
W70-02404 02H

EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

IN SITU TESTS
GEOTECHNICAL ASSESSMENT OF A SITE AT HUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08F

INACTIVATION
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

INCOME REDISTRIBUTION
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

INDIA
MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

QUALITY OF IRRIGATION WATER,
W70-02429 03C

INDIANA
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

INDUCED INFILTRATION
RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUNDWATER-LEVEL CONDITIONS,
W70-02263 04B

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
W70-02290 03A

INDUCED POLARIZATION
FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
W70-02241 07B

INDUSTRIAL PRODUCTION
PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

INDUSTRIAL WASTES
STEEL COMPANY BUILDS FLEXIBLE WASTEWATER TREATMENT SYSTEM,
W70-02176 05D

TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

WATER MANAGEMENT - A NEW WAY OF LIFE,
W70-02297 05G

PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

INDUSTRIAL WATER
ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
W70-02167 03B

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
W70-02285 05G

INDUSTRIAL-MUNICIPAL JOINT WASTE TREATMENT
TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

INFILTRATION
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

WATER REPELLENT SANDS,
W70-02440 02G

INFILTROMETERS
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

INFORMATION DISSEMINATION
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

INFORMATION RETRIEVAL
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

INFORMATION SERVICES
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

INFORMATION SYSTEMS
REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

INFRARED RADIATION
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INHIBITION
SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

INHIBITORS
SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

INJECTION WELLS
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

INSECT POPULATION
PESTICIDES AND STREAM INSECTS,
W70-02371 05C

INSECTICIDE RESISTANT FISHER
INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

INSECTICIDE SUSCEPTIBLE FISHES
INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

INSECTICIDES
PESTICIDES,
W70-02132 05G

EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

INSTALLATION
A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

INSTRUMENTATION
FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

BIBLIOGRAPHY ON THERMAL POLLUTION.
W70-02410 05B

INTERBASIN WATER TRANSFER
INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
W70-02152 06D

INTERDISCIPLINARY TEAMWORK
INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

INTERSTATE COMPACTS
INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
W70-02135 06E

INTER-BASIN TRANSFERS
INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
W70-02152 06D

INTESTINAL MICROORGANISMS
IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

INVISIBLE HAND
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

ION EXCHANGE
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

IONIZING RADIATION
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

IONS
ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

ION-SELECTIVE ELECTRODES
ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

IRAQ
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

IRRIGATED LAND
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

SALTING IN IRRIGATION AREAS,
W70-02433 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

IRRIGATION
CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

IRRIGATION EFFECTS
EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
W70-02280 03C

IRRIGATION EFFICIENCY
DON'T STRESS YOUR WHEAT FOR WATER,
W70-02436 03F

IRRIGATION PRACTICES
THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
W70-02425 02G

IRRIGATION WATER
EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

QUALITY OF IRRIGATION WATER,
W70-02429 03C

IRTYSH RIVER
ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

JAR TESTS
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

JETS
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

ON THE DIFFUSION OF HEATED JETS,
W70-02402 02E

HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

JOINT FILLERS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

JOINTS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

KANSAS
EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

KARST
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

KENTUCKY
FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
W70-02121 02E

KILL RATES
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

KINEMATIC WAVE ANALYSIS
A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

KRAFT
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

LABOR
PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

LABORATORY EQUIPMENT
A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

LAGOONS
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

LAKE ERIE
A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
W70-02254 02H

LAKES
SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
W70-02247 02H

LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A

SMALL ACID BOG LAKE,
W70-02252 02H

PRELIMINARY REPORT OF TEMPERATURE AND OXYGEN UPTAKE IN THE LAKE SCHLIERSEE IN 1956 (GERMAN),
W70-02406 02H

LAND ACQUISITION
SEVERANCE STUDIES,
W70-02147 06E

LAND APPRAISAL
SEVERANCE STUDIES,
W70-02147 06E

LAND CAPABILITY
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

LAND CLASSIFICATION
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06B

THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

LAND USE
RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

LANDSLIDES
THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

SPOIL BANK STABILITY IN EASTERN KENTUCKY,
W70-02210 08D

LANSING(MICH)
GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

LEACHING
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02481 02G

LEAD
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

LEGISLATION
CONGRESS AND WATER RESOURCES,
W70-02160 06E

LEGUMES
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

LEONTIEF MODELS
LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS,
W70-02390 06A

LIGHTHOUSES
BOUNDARIES, JURISDICTION AND EMBLEMS.
W70-02150 06E

LIME
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

LIMNOLOGY
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

LININGS
CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
W70-02281 08F

LITERATURE REVIEW
WASTEWATER TREATMENT,
W70-02196 05D

LOCAL GOVERNMENTS
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

LOESS
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

LOS ALAMOS(NEW MEXICO)
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

LOUISIANA
SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
W70-02094 02L

LOWER RHINE RIVER
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

LOW-TOXICITY EFFLUENTS
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

LYSIMETERS
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

MAGNITUDE
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

MAHOMET BURIED VALLEY(ILL)
GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

MALATHION
PESTICIDES AND STREAM INSECTS,
W70-02371 05C

MANGANESE
MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

MANGANESE TOXICITY SYMPTOMS
MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

MANUAL SERIES
LABOFATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
W70-02316 02J

MAPPING
AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
W70-02066 07C

MARINE GEOLOGY
MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

MARION LAKE(BRITISH COLUMBIA)
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

MARYLAND
CONSERVATION IN A NEW TOWN,
W70-02329 02J

MASS TRANSFER
HEAT AND MASS TRANSFER BETWEEN A WATER SURFACE AND THE ATMOSPHERE.
W70-02401 02D

MATHEMATICAL ANALYSIS
MATHEMATICAL ANALYSIS MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
W70-02380 06B

MATHEMATICAL METHOD
LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS,
W70-02390 06A

MATHEMATICAL MODELS
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT,
W70-02270 05G

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

MATHEMATICAL ANALYSIS MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
W70-02380 06B

LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS,
W70-02390 06A

A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

MATHEMATICAL STUDIES
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

EVALUATION OF ERRORS PRESENT IN WATER BALANCE INVESTIGATIONS (RUSSIAN),
W70-02218 02A

METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

MEANDERS
LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

MEASUREMENT
SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

MEMBRANES
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS,
W70-02063 03A

METAL CORROSION
COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

METAL RECOVERY
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

METEOROLOGY
A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

METHANE
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

METHOD OF CHARACTERISTICS
STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

MICHIGAN
GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

MICROSTRAINING
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

MID-ATLANTIC RIDGE
MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

MIGRATION
AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

MINE DRAINAGE
CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
W70-02128 06E

ABANDONED MINES.
W70-02163 05G

MINE WATER
CONTROL AND DRAINAGE . WATER FROM COAL MINES.
W70-02128 06E

MINERALOGY
PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

MISCONCEPTIONS IN HYDROLOGY
MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

MISSOURI
FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
W70-02088 04A

MIXING
HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

MOBILE DESALTING PLANTS
FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

MODEL STUDIES
MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
W70-02109 08B

SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

MOISTURE AVAILABILITY
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

MOISTURE CONTENT
SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

MOISTURE STRESS
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

DON'T STRESS YOUR WHEAT FOR WATER,
W70-02436 03F

MONITORING
SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

MONOMOLECULAR FILMS
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

MONTANA
WATER QUALITY STANDARDS SUMMARY.
W70-02069 05G

MOTION
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

MOTIVATION
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

MULCHING
CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

MULTIPLE PURPOSE PROJECT
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06B

MULTIPLE-PURPOSE PROJECTS
SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

MULTIPLE-PURPOSE RESERVOIRS
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

MULTISTAGE FLASH DISTILL
EVAPORATION FOR DESALINATION,
W70-02158 03A

MUNICIPAL WASTES
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

MUNICIPAL WATER
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
W70-02167 03E

NABAM
MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
W70-02347 05C

NATIONAL PARKS
WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

NATURAL RESOURCES
EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES,
W70-02168 06B

NAVIGABLE WATERS
CITIZENS COMMITTEE FOR THE HUDSON VALLEY V VOLPE (CONSTRUCTION PERMITS WITHOUT APPROVAL AS REQUIRED BY THE RIVERS AND HARBORS ACT OF 1899).
W70-02061 06E

NAVIGATION
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
W70-02109 08B

CANALS AND POOLS.
W70-02127 06E

NET AID PLAN
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

NETHERLANDS ANTILLES
RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

NEVADA
NOTES ON THE GEOLOGY AND PALEOHYDROLOGY OF THE BOULDER CITY PLUTON, SOUTHERN NEVADA,
W70-02073 02F

NEW JERSEY
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
W70-02122 02E

NEW MEXICO
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

NEW SOUTH WALES
SALTING IN IRRIGATION AREAS,
W70-02433 02G

NEW YORK
FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
W70-02123 02E

NEW ZEALAND
THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

HYDROLOGY ANNUAL NO. 14 - 1966.
W70-02307 02E

HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

NIACIN
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

NITROGEN
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

NITROGEN REMOVAL
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

NOCTURNAL
NOCTURNAL RADIATION LOSS ESTIMATES FOR A FOREST CANOPY,
W70-02200 02D

NON-LINEAR PROGRAMMING
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

NORTHEASTERN RESOURCES COMMISSION
INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
W70-02135 06E

NORWAY
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

NOTTELY DAM
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

NOVA SCOTIA
GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

NUCLEAR MOISTURE METERS
MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
W70-02124 07B

NUTRIENT REQUIREMENTS
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

OAHE RESERVOIR(S DAK)
EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

OBSERVATION WELLS
GROUNDWATER LEVELS IN THE UNITED STATES, 1962-66, NORTH-CENTRAL STATES,
W70-02044 07C

OBSTRUCTIONS TO NAVIGATION
CANALS AND POOLS.
W70-02127 06E

ODOR-PRODUCING ALGAE
CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

OHIO
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

OIL WASTES
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

ON-SITE TESTS
EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
W70-02102 07B

OPEN CHANNEL FLOW
HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
W70-02070 08B

LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

OPEN CHANNELS
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

OPERATION AND MAINTENANCE

OPE-PES

OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

OPERATIONS RESEARCH
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

OPTIMIZATION
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

OREGON
SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W70-02097 02J

WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

ORGANIC MATTER
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

OSCILLATORIA
CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

OUTLETS
SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

OVERBURDEN
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

OVERLAND FLOW
SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

OXALIC ACID
THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

OXIDATION
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

OXYGEN
SURFACE AERATION,
W70-02296 05G

OXYGEN DEMAND
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

OXYGEN REQUIREMENTS
FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
W70-02368 05C

OXYGENATION
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

OYSTERS
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

OZONE
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

O-RING SEALS
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
W70-02133 08A

PALEOCLIMATOLOGY
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

PALEOHYDROLOGY
NOTES ON THE GEOLOGY AND PALEOHYDROLOGY OF THE BOULDER CITY PLUTON, SOUTHERN NEVADA,
W70-02073 02F

PARTIAL TAKING
SEVERANCE STUDIES,
W70-02147 06E

PARTICLE SIZE
THE PARTICLE SIZE SCALE,
W70-02173 08D

TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARICUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

PASTURES
WATER REPELLENT SANDS,
W70-02440 02G

PATH OF POLLUTANTS
STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

PEAK DISCHARGE
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

PEAT
A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

PENNSYLVANIA
WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

CANALS AND POOLS.
W70-02127 06E

CONTROL AND DRAINAGE OF WATER FROM COAL MINES.
W70-02128 06E

ABANDONED MINES.
W70-02163 05G

PER CAPITA LOADINGS
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

PERCOLATION
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

PERMEABILITY
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

PERSISTENCE
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

PESTICIDE RESIDUES
AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

PESTICIDE RESISTANT FISH
CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES,
W70-02315 05C

PESTICIDE TOXICITY
TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
W70-02345 05C

INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS,
W70-02351 05C

CHRONIC ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

PESTICIDES AND STREAM INSECTS,
W70-02371 05C

PESTICIDES
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

PESTICIDES,
W70-02132 05G

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

PETROCHEMICAL WASTES
POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

PETROGRAPHIC INVESTIGATIONS
THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

PHENOL
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

PHILOSOPHY
PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
W70-02382 06B

PHOSPHOROUS
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

PHOSPHOROUS REMOVAL
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

PHOTOGRAMMETRY
AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
W70-02066 07C

PHOTOGRAPHY
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

PHREATOPHYTES
WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

PHYTOPLANKTON
AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
W70-02247 02H

ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
W70-02254 02H

PHYTOTOXICITY
MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

PIEDMONT PLAINS
SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

PILOT PLANTS
FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

PIPE FLOW
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

PIPE JOINTS
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
W70-02133 08A

PIPELINES
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

PIT RECHARGE
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

PLAINS
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

PLANKTON
FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
W70-02404 02H

PLANKTONIC ALGAE
EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

PLANNING
COMPREHENSIVE PLANNING IS IT SUFFICIENT,
W70-02153 06B

PLANNING WATER FOR 2000 A D,
W70-02155 06B

POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

PLANT GROWTH
MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

PLANT PHYSIOLOGY
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

PLANT-AVAILABLE PHOSPHORUS
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

PLASTICS
A NEW METHOD OF INSTALLING PLASTIC MEMBRANES,
W70-02274 04A

CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

PLAYA LAKES
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

POISSON DISTRIBUTION
APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

POLAND
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

POLICY MATTERS
PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
W70-02129 06B

CONGRESS AND WATER RESOURCES,
W70-02160 06E

POLLUTANT IDENTIFICATION
SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

POLLUTANTS
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

POLLUTION ABATEMENT
POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

POLYCHLORINATED BIPHENYLS
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

PORTUGAL
SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

POST-FIRE EROSION
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

POTENTIAL EVAPOTRANSPIRATION
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

POTOMAC RIVER
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

PRECIPITABLE WATER
A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

PRECIPITATION INTENSITY
STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

PRECIPITATION(ATMOSPHERIC)
DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

PRESCRIBED BURNING
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

PRESSURE CONDUITS
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

PRESSURE TUNNELS
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

PRICE STABILITY
A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

PRICES
A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

PRIMARY PRODUCTIVITY
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

PRIMARY TREATMENT
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

PROBABILITY
APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

PRODUCTION FUNCTION
PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

PRODUCTIVITY
ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

PROGRAMMING
PROGRAMMING STRUCTURES IN WATERSHED DEVELOPMENT,
W70-02383 06A

PROJECT PLANNING
FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

PROPIONIC ACID
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

PROTECTIVE COATINGS
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

PROTOZOA
THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

PSYCHOLOGICAL ASPECTS
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

PSYCHOLOGICAL CLIMATE
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

PUBLIC HEALTH
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

SHELLFISH GROUNDS AND PACKING HOUSES.
W70-02268 06E

CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES,
W70-02315 05C

PUBLIC LANDS
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06B

PUBLIC PERCEPTION
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
W70-02278 06E

PUERTO RICO
DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

PULP WASTES
DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

PULPWASTES
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

PUMPING
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

QUATERNARY PERIOD
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

QUICK COVER
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

RADAR
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

RADIATION
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

NOCTURNAL RADIATION LOSS ESTIMATES FOR A FOREST CANOPY,
W70-02200 02D

RADIOACTIVE WASTE DISPOSAL
INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

RADIOACTIVE WASTES
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

RADIOACTIVE WELL LOGGING
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

RADIOACTIVITY EFFECTS
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

RADIOISOTOPES
WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

RAIN
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

RAIN GAGES
EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
W70-02102 07B

RAIN WATER
THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

RAINDROPS
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

RAINFALL
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

RAINFALL SIMULATORS
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

RAINFALL-RUNOFF RELATIONSHIPS
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

INVESTIGATION OF A LINEAR MODEL TO DESCRIBE HYDROLOGIC PHENOMENON OF DRAINAGE BASINS,
W70-02238 02A

A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

RANGE MANAGEMENT
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

RECENT CARBONATE SEDIMENTS
MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

RECLAMATION
TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06B

RECREATION DEMAND
AN ECONOMETRIC MODEL FOR PREDICTING WATER-ORIENTED OUTDOOR RECREATION DEMAND,
W70-02194 06D

RED SEA
GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

REDISTRIBUTIVE RULE
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

REEFS
A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

REFORESTATION
TREE SURVIVAL AND GROWTH ON PESCUE COVERED SPOIL BANKS,
W70-02211 04A

REGIMEN
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

REGULATIONS
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

REMOTE SENSING
SEEPAGE DETECTION BY REMOTE SENSING,
W70-02169 07B

REPRODUCTIVE PHYSIOLOGY
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

RESEARCH AND DEVELOPMENT
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

RESEARCH EQUIPMENT
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

RESEARCH FACILITIES
FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

RESERVOIR EVAPORATION
EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

RESERVOIR LEAKAGE
CONTROL OF SEEPAGE IN EARTH DAMS,
W70-02164 04A

RESERVOIR OPERATION
ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
W70-02111 04A

ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

RESERVOIR SILTING
SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965,
W70-02262 02J

RESERVOIR STORAGE
EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

RESERVOIRS
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS
W70-02166 08E

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
W70-02404 02H

CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

RESERVORS
THERMO-HYDRODYNAMICS OF STREAMS AND RESERVOIRS - GRAPHICAL METHOD FOR THE PREDICTION OF WATER TEMPERATURES WITHIN AND DOWNSTREAM FROM RESERVOIRS.
W70-02397 02H

RESISTIVITY
FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
W70-02241 07B

RESOURCE ALLOCATION
SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

RESOURCE DEVELOPMENT
EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES,
W70-02168 06B

COMMENT ON 'WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT',
W70-02375 06B

RESOURCES
EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES,
W70-02168 06B

RETURN FLOW
EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT,

KANSAS,
W70-02093 05C

REUSE
TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

REVERSE OSMOSIS
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

WATER RECLAMATION BY REVERSE OSMOSIS,
W70-02058 05D

A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS,
W70-02063 03A

REVIEWS
REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
W70-02043 09D

WASTEWATER TREATMENT,
W70-02196 05D

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
W70-02292 02K

RHODE ISLAND
CONTAMINATION OF DRINKING WATER.
W70-02049 05G

INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
W70-02135 06E

SHELLFISH GROUNDS AND PACKING HOUSES.
W70-02268 06E

RIGHT-OF-WAY
SEVERANCE STUDIES,
W70-02147 06E

RIVER BASIN ADMINISTRATION
RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

RIVER BASIN DEVELOPMENT
MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
W70-02379 06A

RIVER BASINS
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
W70-02225 02A

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

RIVER REGULATION
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

RIVER TRAINING
CANAL SHOALING STUDIES,
W70-02108 08B

RIVERS
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

RIVERS AND HARBORS ACT
CITIZENS COMMITTEE FOR THE HUDSON VALLEY V VOLPE (CONSTRUCTION PERMITS WITHOUT APPROVAL AS REQUIRED BY THE RIVERS AND HARBORS ACT OF 1899).
W70-02061 06E

ROAD CONSTRUCTION
CITIZENS COMMITTEE FOR THE HUDSON VALLEY V VOLPE (CONSTRUCTION PERMITS WITHOUT APPROVAL AS REQUIRED BY THE RIVERS AND HARBORS ACT OF 1899).
W70-02061 06E

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

ROADS
LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
W70-02213 04A

ROCK DISSOLUTION
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

ROCK FOUNDATIONS
GEOTECHNICAL ASSESSMENT OF A SITE AT HUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

ROCK MECHANICS
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

ROCKS
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

ROTIFERS
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
W70-02249 05C

ROUGHNESS(HYDRAULIC)
HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
W70-02070 08B

ROUTING
A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

RUBBER
BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

RUNOFF
WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
W70-02225 02A

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

RUNOFF FORECASTING
STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

SAFETY
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

SAFETY FEATURES
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

SALINE SOILS
EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
W70-02280 03C

THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

SALINE WATER
QUALITY OF IRRIGATION WATER,
W70-02429 03C

SALINE WATER INTRUSION
SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
W70-02094 02L

SALINITY
CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALIBE LANDS,
W70-02425 02G

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

SALTING IN IRRIGATION AREAS,
W70-02433 02G

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TUBAN PLAIN,
W70-02439 02G

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

SALMON
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

SALT TRANSPORT
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

SAND WAVES
MECHANICS OF BED FORMATIONS,
W70-02149 08B

SANDS
SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

WATER REPELLENT SANDS,
W70-02440 02G

SAPONIN
INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

SATELLITES(ARTIFICIAL)
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

SCALING
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

SCIENTIFIC PERSONNEL
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

SEA LEVEL
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

SEA WATER
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
W70-02290 03A

THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

SEALANTS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

SEALING COMPOUNDS
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

SEASHORES
THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

SEASONAL
METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

SEDIMENT ANALYSIS
LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
W70-02316 02J

SEDIMENT CONTROL
CONSERVATION IN A NEW TOWN,
W70-02329 02J

SEDIMENT DISTRIBUTION
A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

SEDIMENT LOAD
SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

SEDIMENT TRANSPORT
SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W70-02097 02J

A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
W70-02103 08B

PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

SEDIMENTARY ROCKS
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

SEDIMENTARY STRUCTURES
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

SEDIMENTATION
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
W70-02074 02J

CANAL SHOALING STUDIES,
W70-02108 08B

MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

SEDIMENTOLOGY
LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,

W70-02316 02J

SEDIMENTS
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
W70-02316 02J

SEEPAGE
SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

THE INVESTMENT DECISION FOR SEEPAGE REDUCTION,
W70-02156 06C

SEEPAGE DETECTION BY REMOTE SENSING,
W70-02169 07B

FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

CURRENT SEEPAGE REDUCTION RESEARCH,
W70-02260 04A

SEEPAGE MEASUREMENT
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

SEISMIC SOURCES
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

SEISMOLOGY
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

SELF-PURIFICATION
MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

SEMIARID CLIMATES
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

SETTLING VELOCITY
HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
W70-02074 02J

SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

SEVERANCE
SEVERANCE STUDIES,
W70-02147 06E

SEWAGE
FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

SEWAGE EFFLUENTS
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

SEWAGE TREATMENT
FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

SEWER SEPARATION
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

SEWERAGE COLLECTION
COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, FEASIBILITY OF CONNECTING SEWAGE HOLDING TANKS ON BOARD RECREATIONAL WATERCRAFT TO A DOCKSIDE COLLECTION SYSTEM AND STORAGE IN AN UNDERWATER TANK.
W70-02283 05G

SEWERS
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

SHARES
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

SHEAR STRESS
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
W70-02133 08A

SHOALS
MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
W70-02109 08B

SHORE REFORMATION
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

SHORES
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

SILTS
CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH INCREASED SILT,
W70-02348 05C

SILVER
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

SIMULATION ANALYSIS
REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

SITES
GEOTECHNICAL ASSESSMENT OF A SITE AT HUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

WATERWAY INDUSTRIAL SITES A CHICAGO CASE STUDY,
W70-02386 06B

SIZE
THE PARTICLE SIZE SCALE,
W70-02173 08D

SLUDGE
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

SLUDGE THICKENING
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

SLUDGE TREATMENT
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

SNOW COVER
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

SNOW COVER MAPPING
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

SOCIAL ASPECTS
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
W70-02278 06B

SOCIAL BEHAVIOR
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

SOCIAL NEEDS
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

SOCIAL VALUES
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

SODIUM
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON

PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

QUALITY OF IRRIGATION WATER,
W70-02429 03C

SODIUM PENTOCHLOROPHENATE
THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

SOIL ADDITIVES
MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

SOIL CEMENT
SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
W70-02281 08F

SOIL CHEMICAL PROPERTIES
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALIEE LANDS,
W70-02425 02G

PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

SOIL CLASSIFICATIONS
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

SOIL COMPACTION
COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

SOIL CONSERVATION
RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

SOIL DISPOSAL FIELDS
VIRUS MOVEMENT IN GROUNDWATER SYSTEMS,
W70-02240 05B

SOIL FORMATION
AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

SOIL INVESTIGATIONS
SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

SOIL MECHANICS
SPOIL BANK STABILITY IN EASTERN KENTUCKY,
W70-02210 08D

SOIL MICROBIOLOGY
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

SOIL MOISTURE
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
W70-02124 07B

THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

SOIL PHYSICAL PROPERTIES
SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

SOIL PROFILES
THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

SOIL PROPERTIES
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

SOIL STABILIZATION
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

SOIL SURVEYS
AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
W70-02066 07C

SOIL TEXTURE
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

SOIL WATER
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

SOIL WATER MOVEMENT
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

SOILS
CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

SOIL-WATER-PLANT RELATIONSHIPS
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

SOLAR RADIATION
WATER RESOURCE OBSERVATORY SOLAR RADIATION DATA-WATER YEAR 1969 AND PRIOR.
W70-02242 07C

WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

SOLAR REFLECTION
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

SOLUBILITY
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
W70-02292 02K

SOLUTES REJECTION
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

SOUTH AFRICA
DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

SOUTH BONAIRE
RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

SOUTH DAKOTA
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

SOUTHWEST U
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

SPECTROPHOTOMETRY
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,

W70-02099 02K

SPIRAL FLOW
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

SPOIL BANKS
LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
W70-02213 04A

FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

SPRING WATERS
DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

SPRINGS
DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

STABILITY
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

STABILIZATION
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

STABILIZATION-RETENTION BASIN SEWERAGE SEPARATION
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

STAGE-DISCHARGE RELATIONS
THE EFFECT OF SEEPAGE LOSSES ON STREAM REGIMEN,
W70-02273 04A

STANDARDS
WATER QUALITY STANDARDS SUMMARY.
W70-02069 05G

STATE AID
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

STATE JURISDICTION
BOUNDARIES, JURISDICTION AND EMBLEMS.
W70-02150 06E

STATISTICAL METHODS
APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
W70-02111 04A

ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

STATISTICAL MODELS
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

STEEL
STEEL COMPANY BUILDS FLEXIBLE WASTEWATER TREATMENT SYSTEM,
W70-02176 05D

STEEL LININGS
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

STEEL PIPES
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

STOCHASTIC PROCESSES
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

STORM DRAINS
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

STORM RUNOFF
FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

STORM SEWAGE
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

STRATIFICATION
EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

STRATIGRAPHY
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

STREAMBED ELEVATIONS
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

STREAMBEDS
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

MECHANICS OF BED FORMATIONS,
W70-02149 08B

STREAMFLOW
WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

TEMPERATURE ANALYSIS OF A STREAM,
W70-02062 02E

DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

STREAMFLOW FORECASTING
ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
W70-02111 04A

STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

STREAMS
MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

STRESS ANALYSIS
EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

STRIP MINES
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

SPOIL BANK STABILITY IN EASTERN KENTUCKY,
W70-02210 08D

TREE SURVIVAL AND GROWTH ON FESCUE COVERED SPOIL BANKS,
W70-02211 04A

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
W70-02213 04A

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

STRIP-MINE RECLAMATION
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

STRUCTURAL GEOLOGY
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

STRUCTURAL STABILITY
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

STUBBLE MULCHING
CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

SUB-ARCTIC CLIMATE
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
W70-02178 05D

SULFURIC ACID
THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

SURFACE AERATION
SURFACE AERATION,
W70-02296 05G

SURFACE DRAINAGE
HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

SURFACE RUNOFF
METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

SURFACE WATERS
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
W70-02114 07C

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
W70-02115 07C

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

SURFACE-GROUNDWATER RELATIONSHIPS
EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

SURGES
EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
W70-02157 08C

SURVEYS
SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
W70-02094 02L

WASTEWATER TREATMENT,
W70-02196 05D

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

ROADSIDE EROSION SURVEY,
W70-02327 02J

SUSPENDED LOAD
SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

SYMPOSIA
A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

SYNOPTIC ANALYSIS
A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

SYNTHETIC HYDROLOGY
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

SYSTEMS ANALYSIS
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT,
W70-02270 05G

TAMARISK
WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

TASTE-PRODUCING ALGAE
CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

TECHNICAL FEASIBILITY
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

TEMPERATURE
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

PRELIMINARY REPORT OF TEMPERATURE AND OXYGEN UPTAKE IN THE LAKE SCHLIERSEE IN 1956 (GERMAN),
W70-02406 02H

THERMAL MODIFICATION OF RIVER WATER QUALITY,
W70-02408 07C

TEMPERATURE CONTROL
CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

TEMPORAL DISTRIBUTION
THERMAL MODIFICATION OF RIVER WATER QUALITY,
W70-02408 07C

TENNESSEE
GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

TENNESSEE RIVER
CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

TENSION
SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

TERMITES
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

TERTIARY TREATMENT
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

TEXAS
GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

THAMES RIVER
FISH-LIFE AND POLLUTION IN THE LOWER THAMES A REVIEW AND PRELIMINARY REPORT,
W70-02356 05C

THERMAL POLLUTION
A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

A COOLING POND PROVES CHEAPER,
W70-02409 05D

BIBLIOGRAPHY ON THERMAL POLLUTION.
W70-02410 05B

THERMAL POWER
THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

THERMAL POWERPLANTS
SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

THERMAL RADIATION
NOCTURNAL RADIATION LOSS ESTIMATES FOR A FOREST CANOPY,
W70-02200 02D

W70-02200 02D

THERMAL STRATIFICATION
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR TEE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

THERMO-HYDRODYNAMICS OF STREAMS AND RESERVOIRS - GRAPHICAL METHOD FOR THE PREDICTION OF WATER TEMPERATURES WITHIN AND DOWNSTREAM FROM RESERVOIRS.
W70-02397 02H

CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

THERMAL WATER
THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

THERMOCLINE
EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

THIN FILMS
INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03E

THORNTHWAITE
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

TIDES
MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

TIME SERIES ANALYSIS
TEMPERATURE ANALYSIS OF A STREAM,
W70-02062 02E

APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

TIMESCALE
THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

TOLERANCES(MECHANICS)
EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

TOPOGRAPHY
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

TOWERS
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

TOXICANT DILUTING SYSTEMS
A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

TOXICITY
EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
W70-02366 05C

TRACE ELEMENTS
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

TRACERS
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

TRACTIVE FORCES
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

TRANSIENT STABILITY
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

TRANSMISSION TOWERS
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

TRANSMISSION(ELECTRICAL)
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

TREATMENT
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

TREE ESTABLISHMENT(NEW SEDIMENTS)
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

TREES
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

TRENTON(NJ)
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

TRISODIUM NITRILOTRIACETATE
TRISODIUM NITRILOTRIACETATE AND ALGAE,
W70-02248 05C

TSUNAMIS
CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

TUBIFICIDS

THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

TUNNEL DESIGN
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

TUNNEL LININGS
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

TURAN PLAIN
THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

TURBINE RUNNERS
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

TURBINES
EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
W70-02157 08C

TURBULENT FLOW
HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
W70-02070 08B

ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

ULTRAVIOLET RADIATION
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

UMPQUA RIVER BASIN(ORE)
SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W70-02097 02J

UNDERGROUND STORAGE
COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, FEASIBILITY OF CONNECTING SEWAGE HOLDING TANKS ON BOARD RECREATIONAL WATERCRAFT TO A DOCKSIDE COLLECTION SYSTEM AND STORAGE IN AN UNDERWATER TANK.
W70-02283 05G

UNDERWATER STORAGE
COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, FEASIBILITY OF CONNECTING SEWAGE HOLDING TANKS ON BOARD RECREATIONAL WATERCRAFT TO A DOCKSIDE COLLECTION SYSTEM AND STORAGE IN AN UNDERWATER TANK.
W70-02283 05G

UNITED STATES
DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

UNITED STATES CONGRESS
CONGRESS AND WATER RESOURCES,
W70-02160 06E

USSR
WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
W70-02225 02A

MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

UZBECK SSR
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

VALLEYS
GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

VALUE
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

VEGETATION
METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

VEGETATION EFFECTS
TREE SURVIVAL AND GROWTH ON RESCUE COVERED SPOIL BANKS,
W70-02211 04A

VEGETATION ESTABLISHMENT
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

VELOCITY
TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

VELOCITY DISTRIBUTION
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

VEL-WAT

EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

VERMONT
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

VIRGINIA
BOUNDARIES, JURISDICTION AND EMBLEMS.
W70-02150 06E

VIRUSES
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

VIRUS MOVEMENT IN GROUNDWATER SYSTEMS,
W70-02240 05B

VOLATILE ACIDS
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

WASHINGTON
CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
W70-02060 02E

WASHOUTS
EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

WASTE ASSIMILATIVE CAPACITY
IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

WASTE DISPOSAL
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

WASTE GRINDERS
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

WASTE STORAGE
COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, FEASIBILITY OF CONNECTING SEWAGE HOLDING TANKS ON BOARD RECREATIONAL WATERCRAFT TO A DOCKSIDE COLLECTION SYSTEM AND STORAGE IN AN UNDERWATER TANK.
W70-02283 05G

WASTE TREATMENT
AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

WATER MANAGEMENT - A NEW WAY OF LIFE,
W70-02297 05G

CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

WASTE WATER DISPOSAL
COMBINED SEWER SEPARATION USING PRESSURE SEWERS.
W70-02392 05G

WASTE WATER TREATMENT
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

WASTE WATER(POLLUTION)
SURFACE AERATION,
W70-02296 05G

EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

WASTES
THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

WASTEWATER TREATMENT
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

WATER ANALYSIS
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

WATER BALANCE
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

EVALUATION OF ERRORS PRESENT IN WATER BALANCE INVESTIGATIONS (RUSSIAN),
W70-02218 02A

WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

WATER CHEMISTRY
WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
W70-02292 02K

DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

WATER CIRCULATION
A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

WATER CONSERVATION
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

WATER CONSUMPTION
PLANNING WATER FOR 2000 A D,
W70-02155 06B

WATER DEMAND
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

PLANNING WATER FOR 2000 A D,
W70-02155 06B

TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

WATER LEVEL FLUCTUATIONS
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

WATER LEVELS
GROUNDWATER LEVELS IN THE UNITED STATES, 1962-66, NORTH-CENTRAL STATES,
W70-02044 07C

EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

WATER LOSS
SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

WATER MANAGEMENT(APPLIED)
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

WATER MANAGEMENT - A NEW WAY OF LIFE,
W70-02297 05G

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

WATER MEASUREMENT
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

WATER POLLUTION
ABANDONED MINES.
W70-02163 05G

VIRUS MOVEMENT IN GROUNDWATER SYSTEMS,
W70-02240 05B

SHELLFISH GROUNDS AND PACKING HOUSES.
W70-02268 06E

EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF ROCK TROUT,
W70-02346 05C

WATER POLLUTION CONTROL
CONTAMINATION OF DRINKING WATER.
W70-02049 05G

COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT,
W70-02270 05G

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
W70-02285 05G

CENTRIFUGES REDUCE WATER POLLUTION,
W70-02295 05G

TECHNICAL ASPECTS OF JOINT WASTE TREATMENT -- MUNICIPAL/INDUSTRIAL,
W70-02319 05D

FISH-LIFE AND POLLUTION IN THE LOWER THAMES A REVIEW AND PRELIMINARY REPORT,
W70-02356 05C

WATER POLLUTION SOURCES
CONTAMINATION OF DRINKING WATER.
W70-02049 05G

EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

WATER POLLUTION TREATMENT
PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
W70-02285 05G

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

WATER POLLUTION TRENDS
EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

WATER POTENTIAL
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

WATER QUALITY
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

WATER QUALITY STANDARDS SUMMARY.
W70-02069 05G

GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
W70-02114 07C

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
W70-02115 07C

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

QUALITY OF IRRIGATION WATER,
W70-02429 03C

WATER QUALITY ACT
WATER QUALITY STANDARDS SUMMARY.
W70-02069 05G

WATER QUALITY CONTROL
WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

WATER QUALITY INDICATORS
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
W70-02360 05C

WATER RATES
WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

WATER RESOURCES
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
W70-02060 02E

PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
W70-02152 06D

CONGRESS AND WATER RESOURCES,
W70-02160 06E

ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

ECONOMICS OF WATERSHED PLANNING.
W70-02374 06B

WATER RESOURCES DEVELOPMENT
REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
W70-02043 09D

VALIDATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

INTERSTATE COMPACTS FOR PROTECTION OF RESOURCES.
W70-02135 06E

COMPREHENSIVE PLANNING IS IT SUFFICIENT,
W70-02153 06B

MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

WATER RESOURCES RESEARCH
REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
W70-02043 09D

WATER RESOURCES RESEARCH ACT
REPORT ON FOURTH ANNUAL WATER RESOURCES RESEARCH CONFERENCE SPONSORED BY OWRR.
W70-02043 09D

WATER REUSE
WATER RECLAMATION BY REVERSE OSMOSIS,
W70-02058 05D

BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
W70-02285 05G

COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

WATER SPREADING
SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

WATER SUPPLY
CONTAMINATION OF DRINKING WATER.
W70-02049 05G

DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

PLANNING WATER FOR 2000 A D,
W70-02155 06B

ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
W70-02167 03E

MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

BIBLIOGRAPHY ON THERMAL POLLUTION.
W70-02410 05B

WATER SUPPLY FORECASTING
PLANNING WATER FOR 2000 A D,
W70-02155 06B

ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
W70-02167 03E

WATER TEMPERATURE
TEMPERATURE ANALYSIS OF A STREAM,
W70-02062 02E

POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

A SYMPOSIUM ON WATER QUALITY CRITERIA TO PROTECT AQUATIC LIFE, PRESENTED AT 96TH ANNUAL MEETING KANSAS CITY, MISSOURI, SEPTEMBER 1966.
W70-02246 05G

THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

THERMO-HYDRODYNAMICS OF STREAMS AND RESERVOIRS - GRAPHICAL METHOD FOR THE PREDICTION OF WATER TEMPERATURES WITHIN AND DOWNSTREAM FROM RESERVOIRS.
W70-02397 02H

IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

WATER TREATMENT
COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

WATER UTILIZATION
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

WATER WELLS
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

WELLS PROVIDE SEA WATER - NATURALLY FILTERED.
W70-02290 03A

WATER YIELD
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

WATERSHED DEVELOPMENT
COMMENT ON 'WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT',
W70-02375 06B

WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT,
W70-02376 06B

MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
W70-02379 06A

PROGRAMMING STRUCTURES IN WATERSHED DEVELOPMENT,
W70-02383 06A

WATERSHED MANAGEMENT
HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

ECONOMICS OF WATERSHED PLANNING.
W70-02374 06B

PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
W70-02382 06B

WATERSHED PLANNING
ECONOMICS OF WATERSHED PLANNING.
W70-02374 06B

INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

MATHEMATICAL ANALYSIS MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
W70-02380 06B

WATERSHED POLICY
PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
W70-02382 06B

WATERSHEDS
ECONOMICS OF WATERSHED PLANNING.
W70-02374 06B

MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
W70-02379 06A

COMMENT ON 'PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY',
W70-02381 06B

WATERSHEDS(BASINS)
DECADE REPRESENTATIVE AND EXPERIMENTAL RESEARCH BASINS IN THE UNITED STATES.
W70-02064 07A

WAVES(WATER)
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

WEAK AMMONIA LIQUOR
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

WEATHER MODIFICATION
PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
W70-02129 06B

ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

WEATHERING
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

WEBSTER SUL-BI SUL DESALTING
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

WEBSTER(S DAK)
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

WELFARE
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

WELL RECHARGE
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

WESTERN U
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06E

CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

WETTABILITY
WATER REPELLENT SANDS,
W70-02440 02G

WHEAT
DON'T STRESS YOUR WHEAT FOR WATER,
W70-02436 03F

WIND VELOCITY
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

WINDS
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

WINTERFAT
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

WISCONSIN
ROADSIDE EROSION SURVEY,
W70-02327 02J

WORKING CONDITIONS
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

ZETA
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

ZIMMERMAN PROCESS
PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

ZINC
THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

AUTHOR INDEX

ADOLPHSON, DONALD G.
BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
W70-02317 02F

AFIFI, HAMDY H. H.
WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

ALBERTSON, ORRIS E.
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

ALEXANDER, G. N.
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

ALEXANDER, W. H., JR.
GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

ALKINSON, A. B.
THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

ALLBAUGH, LELAND G.
COMMENT ON 'PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY',
W70-02381 06B

ALLMAN, DAVID W.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

AL-RAEBAT, MOHAMAD FOUAD
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

AMER, FATHI
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

ANDELMAN, JULIAN B.
ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

ANDERSON, DANIEL W.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

ANDERSON, E. ERNEST
NOTES ON THE GEOLOGY AND PALEOHYDROLOGY OF THE BOULDER CITY PLUTON, SOUTHERN NEVADA,
W70-02073 02F

APOSTOL, SIMONA
THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
W70-02366 05C

INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
W70-02368 05C

THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

ARONSON, A. IA.
EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

AUEIN, A. E.
THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
W70-02361 05C

AZARKOVICH, YE. SH.
SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

BAKER, ROBERT A., JR.
DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

BAKER, SAMUEL ERICK
A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

BALLANTINE, D. S.
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

BALLWEG, JOHN A.
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
W70-02278 06B

BALL, J. W.
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

BANERJI, S. K.
WASTEWATER TREATMENT,
W70-02196 05D

BARNES, JAMES C.
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

BARTH, EDWIN F.
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

BASSIE, V. LEWIS
WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

BASUMALLICK, SUDHIR
MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

BAUM, EMANUAL L.
COMMENT ON 'PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY',
W70-02381 06B

BEARD, JAMES T.
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

BEAVER, J. A.
MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

BEHLKE, C. E.
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

BELLPORT, B. P.
COMPREHENSIVE PLANNING IS IT SUFFICIENT,
W70-02153 06B

BENSON, JAMES D.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

BENSON, J. D.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

BERGEN, JAMES D.
NOCTURNAL RADIATION LOSS ESTIMATES FOR A FOREST CANOPY,
W70-02200 02D

BERG, WILLIAM A.
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

BERKHOV, N. F.
EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

BETZER, NACHUM
EFFECT OF HALOGENS ON ALGAE - II. CLADOPHORA SP.,
W70-02364 05C

BINGHAM, F. T.
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,

W70-02438 02I

BIRKHEAD, GUTHRIE S.
RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

BISHOP, D. F.
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

BLACKWELDER, BLAKE W.
MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

BLACK, PETER E.
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

BLEASE, JOHN A.
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

BOBCHENKO, V. E.
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

BOHLMANN, E. G.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

BOLTON, N. E.
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

BOND, R. D.
WATER REPELLENT SANDS,
W70-02440 02G

BORCH, KARL
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

BOROVSKIY, V. M.
CRITERIA FOR THE EVALUATION OF THE DEGREE OF SOIL SALINITY FOR THE PURPOSE OF IRRIGATION (RUSSIAN),
W70-02418 03C

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN,
W70-02439 02G

BOWLEY, CLINTON J.
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY,
W70-02314 07B

BOYD, J. W.
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

BOYKIN, JAMES H.
SEVERANCE STUDIES,
W70-02147 06E

BOYLE, W. C.
WASTEWATER TREATMENT,
W70-02196 05D

BRASWELL, R. W.
A COOLING POND PROVES CHEAPER,
W70-02409 05D

BRENNER, RICHARD C.
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

BREWER, DURWARD
AN ECONOMETRIC MODEL FOR PREDICTING WATER-ORIENTED OUTDOOR RECREATION DEMAND,
W70 02194 06D

BRIGGS, WILLIAM M.
ROADSIDE EROSION SURVEY,
W70-02327 02J

BRIGG, J. C., JR.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

BRINSER, AYERS
MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
W70-02379 06A

BROCKWAY, C. E.
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

BUHLER, DONALD R.
CHRONIT ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

BUIE, EUGENE C.
INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

BULAVKO, A. G.
EVALUATION OF ERRORS PRESENT IN WATER BALANCE INVESTIGATIONS (RUSSIAN),
W70-02218 02A

BUNCH, B. L.
WASTEWATER TREATMENT,
W70-02196 05D

BURKE, W. DAVID
A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

BURKHEAD, JESSE
RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

BURLAND, J. B.
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

BURLEY, M. J.
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

CADA, R. L.
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

CAMPBELL, I. B.
SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

CARDARELLI, NATHAN F.
BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

CARMICHAEL, ERNEST F.
INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

CARRIGAN, P. H., JR.
APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

CARSWELL, LOUIS D.
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

CASPER, VICTOR L.
A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
W70-02254 02H

CASPER, V. L.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

CASSIDY, J. J.
EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING,
W70-02157 08C

CASTLE, EMERY N.
PROGRAMMING STRUCTURES IN WATERSHED DEVELOPMENT,
W70-02383 06A

CEDERGREN, HARRY R.
CONTROL OF SEEPAGE IN EARTH DAMS,
W70-02164 04A

CHAMPION, W. A.
SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965,
W70-02262 02J

CHAO, T. T.
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

CHATTERJI, A. K.
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

CHATTERTON, N. J.
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

CHERRINGTON, A. D.
IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

CHILINGARIAN, GEORGE V.
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

CHRISTENSEN, ROBERT E.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

CHRISTIE, A. E.
EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

TRISODIUM NITRILOTRIACETATE AND ALGAE,
W70-02248 05C

CHRISTMAN, RUSSELL F.
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

CHURCHILL, M. A.
CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

CIRIACY-WANTRUP, S. V.
PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
W70-02382 06B

CLAPIDGE, G. G. C.
SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

CLIFTON, H. EDWARD
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

CLUFF, C. BRENT
A NEW METHOD OF INSTALLING PLASTIC MEMBRANES,
W70-02274 04A

COLE, J. A.
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

COLLINGS, M. R.
TEMPERATURE ANALYSIS OF A STREAM,
W70-02062 02E

SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

COOK, PHILIP W.
AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
W70-02247 02H

COON, FRANCIS E.
AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

COOPER, CHARLES F.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

COOPER, JAMES P.
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

COPE, OLIVER
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

COX, DOAK C.
CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

CRINER, JAMES H.
GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

CRIPPEN, ROBERT W.
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
W70-02360 05C

CROSS, B. P.
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

CROTCHFIELD, JAMES A.
WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

CSALLANY, SANDOR C.
PLANNING WATER FOR 2000 A D,
W70-02155 06B

CUNHA, L. V.
SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

CURTIS, LAMONT W.
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

CURTIS, WILLIE R.
FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

CZAPOWSKYJ, MIROSLAW M.
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

DALALY, H.
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

DAVIS, GRANT
HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

DAVIS, L. G.
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

DAVTYAN, M. A.
WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

DAWSON, ROBERT N.
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

DAY, A. D.
DON'T STRESS YOUR WHEAT FOR WATER,
W70-02436 03F

DE VRIES, M.
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

DEL MANZO, DONALD D.
THE EFFECT OF SEEPAGE LOSSES ON STREAM REGIMEN,
W70-02273 04A

DENDY, F. E.
SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965,
W70-02262 02J

DEPREE, DAVID O.
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

DI TORO, DOMINIC M.
STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

DIAPER, E. W. J.
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

DICKERSON, B. W.
PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

DIMOND, JOHN
PESTICIDES AND STREAM INSECTS,
W70-02371 05C

DIMOND, JOHN B.
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

DOMENICO, P. A.
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

DOMINY, FLOYD E.
ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT,
W70-02167 03E

DONOHUE, JOHN M.
COOLING WATER CHEMICAL TREATMENTS,
W70-02294 05D

DORFMAN, D.
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

DORRIS, TROY C.
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

DRAKE, THOMAS L.
FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
W70-02241 07B

DREWRY, WILLIAM A.
VIRUS MOVEMENT IN GROUNDWATER SYSTEMS,
W70-02240 05B

DREW, H. R.

THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

DRISCOLL, E. D.
SURFACE AERATION,
W70-02296 05G

DROBNY, NEIL L.
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW,
W70-02151 06A

DUGAN, H. P.
COMPREHENSIVE PLANNING IS IT SUFFICIENT,
W70-02153 06B

DUMAS, ANDRE J.
STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

DVORACEK, MARVIN J.
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

DVOROV, I. M.
THE PROSPECTS OF UTILIZATION OF THERMAL WATERS (THE MAKHACHKALA CONFERENCE) (RUSSIAN),
W70-02419 03C

DZEKTSER, YE S.
A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

EAGLESON, PETER S.
A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

EASTER, K. WILLIAM
INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
W70-02152 06D

ECKENFELDER, W. W., JR.
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

EDIIS, J.
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

EGOROV, V. V.
SALINIZATION OF SOILS OF PIEDMONT PLAINS,
W70-02434 02G

EHLMANN, ARTHUR J.
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

EKMAN, S. R.
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

ELDER, REX A.
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

ELLER, LAFAYETTE
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

ELLIS, MICHAEL J.
BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
W70-02317 02F

ELSON, P. F.
EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS,
W70-02351 05C

ERNEST, LAWRENCE A.
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

ESVELT, LARRY A.
AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A STUDY OF AERATED LAGOON, ACTIVATED SLUDGE AND ACTIVATED SLUDGE WITH SLUDGE REAERATION IN THE TREATMENT OF FRUIT CANNERY WASTE,
W70-02284 05D

EVANS, G. N.
SALTING IN IRRIGATION AREAS,
W70-02433 02G

EVENSON, DONALD E.
SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

FARLEKAS, GEORGE M.
FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
W70-02122 02E

FELKEL, KARL
A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH),
W70-02103 08E

FERGUSON, DENZEL E.
CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES,
W70-02315 05C

TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
W70-02345 05C

SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLOCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

FERREIRA, J. F.
SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,
W70-02107 08B

FIDLER, RICHARD E.
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST CHIC BY NATURAL GAMMA LOGGING,
W70-02079 07B

FIEHN, A. J.
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

FIELDS, F. K.
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

FIFE, C. LYNN
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

FINLEY, MACK T.
INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

FISHBECK, K. A.
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

FISHMAN, M. J.
DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

FLECKSTEINER, JOHN W.
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

FLEMING, GEORGE
SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

FLUKE, G. A.
A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS,
W70-02063 03A

FORD, DAVIS L.
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

FORD, W. L.
MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

FOSSUM, JOHN H.
WATER RECLAMATION BY REVERSE OSMOSIS,
W70-02058 05D

FOX, M. A.
CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

FRANCO, JOHN J.
CANAL SHOALING STUDIES,
W70-02108 08B

FRANKEL, M. L.
MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

FRANK, F. J.
WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

FRENCH, B. K.
MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
W70-02124 07B

FRIEDMAN, GERALD M.

POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

FRUH, E. GUS
THE OVERALL PICTURE OF EUTROPHICATION,
W70-02251 05C

GAINER, JOHN L.
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

GAINES, J. L.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

GALLIHER, CLAIBORNE F.
HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

GALLOIS, R. W.
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

GARNER, D. M.
THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY,
W70-02302 02K

GAVRICHENKOVA, I. V.
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

GEL'BURH, T. M.
EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

GERAEHLING, CL.
PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

GERLOFF, G. C.
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

GETCHELL, A. STANLEY
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

GHEDERIM, V.
SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

GHITA, I.
SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

GIBBONS, DONALD
PESTICIDES,
W70-02132 05G

GIBSON, JAMES E.
SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

GIEBINK, NORMAN G.
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

GILBERT, CAROLINE CHAPMAN
TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
W70-02345 05C

GILLESPIE, GLENN A.
AN ECONOMETRIC MODEL FOR PREDICTING WATER-ORIENTED OUTDOOR RECREATION DEMAND,
W70-02194 06D

GOLDSTON, S. E.
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

GOLUEKE, C. G.
EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

GOODIN, J. R.
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

GOOLSBY, D. A.
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

GORELIK, A. G.
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

GRABER, F. M.
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

GRAF, EDWARD D.
COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

GRAHAM, RICHARD J.
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

GRAINGE, JOHN W.
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

GRAMMATICATI, O. G.
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

GRAM, RALPH
A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

GRAVES, QUINTIN B.
AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

GREENWOOD, BRIAN
SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

GREER, G. L.
DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
W70-02341 05C

GRIANKO, L. P.
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

GRIGG, NEIL S.
HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
W70-02074 02J

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

GROBE, GARETH A.
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
W70-02178 05D

GUIDI, EUGENE E., JR.
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

GUY, HAROLD P.
LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
W70-02316 02J

HADJITHEODOROU, CHRISTOS
LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

HALPON, A.
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

HAMILTON, H. R.
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

HAMMERSTROM, R. J.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

HAM, ROBERT K.
THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
W70-02292 02K

HANNUM, CURTIS H.
FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
W70-02121 02E

HARGRAVE, BARRY T.
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE,
W70-02244 02H

HARRIS, A. B.
WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

HASLER, ARTHUR D.
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
W70-02249 05C

HAUGHEY, A.
FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS,
W70-02304 05C

HAYAKAWA, NORIO
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

HEADY, EARL O.
MATHEMATICAL ANALYSIS MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
W70-02380 06B

HENDRICKS, E. L.
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07E

HERBICH, JOHN B.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

HERBICH, J. B.
REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

HERMANSON, RONALD E.
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

HERSHKOVITZ, GALILA
ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

HERTZBERG, LEE B.
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

HETHERINGTON, W. M., III.
THE EFFECTS OF HYPER- AND HYPO-CHLORINITIES ON MEMBERS OF THE WOOD-BORING GENUS LIMNORIA,
W70-02372 05C

HICKEY, JOHN J.
VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

HICKEY, JOSEPH J.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

HINES, MARION S.
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

HIRSCH, LAWRENCE
TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

HLADIO, STEPHEN
FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
W70-02123 02E

HOFFMAN, RONALD F.
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

HOLEMAN, JOHN N.
CONSERVATION IN A NEW TOWN,
W70-02329 02J

HOLLEN, DAVID K.
INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

HOUSNER, G. W.
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

HOWARD, GEORGE W.
MOTIVATION OF SCIENTISTS AND ENGINEERS,
W70-02148 09B

HOWELLS, LEWIS W.
GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

HUGHES, DONALD F.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

HUIBERS, D. TH. A.
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

HULL, JOHN E.
HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

HULL, J. E.
SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

HUTCHINSON, G. E.
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

HUTTON, J. T.
THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

HUXEL, C. J.
PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

IBSEN, CHARLES A.
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
W70-02278 06B

IDRISS, I. M.
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

IL'IN, N. I.
A METHOD OF RADIOACTIVE INDICATOR DILUTION FOR EVALUATION OF WATER CIRCULATION IN PEAT BOGS (RUSSIAN),
W70-02416 02G

INTALAP, SUHBAWATR
DON'T STRESS YOUR WHEAT FOR WATER,
W70-02436 03F

ISERI, KATHLEEN T.
DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

ISRAELSEN, EUGENE K.
SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

JAAG, O.
MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

JACKSON, JOE L.
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA,
W70-02131 08E

JACOBS, H. S.
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

JASKE, R. T.
A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

THERMAL MODIFICATION OF RIVER WATER QUALITY,
W70-02408 07C

JOHANSEN, P. H.
THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
W70-02361 05C

JOHNSON, J. O., JR.
WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

JOHNSON, J. S.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

JOHNSON, J. S., JR.

HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

JOHNSON, P. R.
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

JOHNS, H.
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT,
W70-02137 08G

JOLLY, WILLIAM C.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

JONES, DOUGLAS M. A.
EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
W70-02102 07B

JONES, ELIZABETH
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
W70-02249 05C

JUDD, HARL E.
HYDRAULICS OF LARGE BED ELEMENT CHANNELS,
W70-02070 08B

KADOW, A.
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

KADRI, I.
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS,
W70-02430 02G

KAEONCE, RAYMOND E.
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

KAGAN, E. M.
EFFECT OF MANUFACTURING TOLERANCES ON THE STRESS STATE OF RUNNERS FOR FRANCIS HYDRAULIC TURBINES,
W70-02139 08C

KAMRANY, N. M.
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

KANWAR, R. S.
QUALITY OF IRRIGATION WATER,
W70-02429 03C

KANWAR, J. S.
QUALITY OF IRRIGATION WATER,
W70-02429 03C

KAROLY, A.
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

KARR, MALCOLM H.
EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES,
W70-02168 06B

KASABACH, HAIG F.
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

KATZ, WILLIAM J.
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

KAUFERLE, J.
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

KEIGHTON, WALTER B.
WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

KEITH, J. A.
AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

KEMMERICH, A. O.
A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN),
W70-02225 02A

KERSWILL, C. J.
FISH LOSSES AFTER FOREST SPRAYING WITH INSECTICIDES IN NEW BRUNSWICK, 1952-62, AS SHOWN BY CAGED SPECIMENS AND OTHER OBSERVATIONS,
W70-02344 05C

KIEFER, FRED W.
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

KLEIN, G. K.
STABILITY OF TOWER STRUCTURES WITH SHALLOW FOOTINGS ON SOIL,
W70-02141 08D

KLIPPEL, R. W.
POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

KNILL, J. L.
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

KOCH, NEIL C.
EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

KOHLHAAS, CHARLES A.
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

KOONCE, JOSEPH F.
ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

KORNACKI, M. Z.
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

KOSTENBADER, PAUL D.
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR,
W70-02181 05D

KOS, DENNIS D.
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

KOTT, YEHUDA
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

EFFECT OF HALOGENS ON ALGAE - II. CLADOPHORA SP.,
W70-02364 05C

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

KOVDA, V. A.
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

KRAUS, K. A.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

KRENKEL, P. A.
IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

KRISHNAN, PA.
DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

KRIZ, G. J.
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

KRUSE, G. H.
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

KRYNSKIY, V. M.
DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

KUEMEN, PH. H.
SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

LACY, WILLIAM J.
PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTION CONTROL ADMINISTRATION),
W70-02285 05G

LANE, RICHARD D.
FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

LAWLER, ELIZABETH A.
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,

W70-02090 05D

LAWRENCE, ALONZO W.
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

LEARY, RAYMOND D.
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

LEBRETON, J. CL.
PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08E

LEE, FAN-HSIU
SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

LEE, K. E.
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

LEE, RONALD A.
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

LEONARD, ROBERT B.
EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

LEVE, G. W.
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

LEWIS, RONALD F.
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,
W70-02310 05D

LIESTOL, OLAV
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

LIPSCOMB, ERNEST B.
CANAL SHOALING STUDIES,
W70-02108 08E

LOGUNOV, V. F.
THE USE OF DOPPLER RADAR EQUIPMENT TO DETERMINE THE VERTICAL AIR VELOCITY IN RAIN,
W70-02056 07B

LONG, I. F.
MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
W70-02124 07B

LONSDALE, H. K.
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

LOTHROP, THOMAS L.
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

LOVELL, C. W., JR.
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

LUCIA, F. J.
RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

LUDKE, J. LARRY
SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

LYAPIN, A. N.
MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

LYLE, C. V.
THE STATE OF ECONOMIC DATA,
W70-02378 06B

LYUTIK, P. M.
ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

MADDAUS, WILLIAM O.
A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

MADDEN, JOHN M.
EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
W70-02280 03C

MAJOR, C. J.
BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

MAJUMDAR, K. C.
ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
W70-02111 04A

MALLORY, E. C.
WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

MANN, DEAN E.
PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
W70-02129 06B

MARKOVA, O. L.
WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

MARKS, DAVID H.
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

MARTIN, ROSCOE C.
RIVER BASIN ADMINISTRATION AND THE DELAWARE,
W70-02387 06E

MASCH, FRANK D.
METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

MATSON, ARTHUR J.
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

MATYUKHIN, V. I.
TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

MAY, ROBERT F.
ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MCCARREN, EDWARD F.
WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

MCCARTY, PERRY L.
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

MCCRAREN, JOSEPH P.
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS,
W70-02359 05C

MCGUINNESS, C. L.
GROUNDWATER LEVELS IN THE UNITED STATES, 1962-66, NORTH-CENTRAL STATES,
W70-02044 07C

MCKEAN, JOHN R.
A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

MCKELL, C. M.
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

MCLEAN, JOHN E.
INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

MCNABNEY, R.
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

MEINERS, ALFRED F.
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

MELHORN, W. N.
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

MESSINGER, H.
DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
W70-02414 05B

MEYER, F. W.
SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE,

FLORIDA,
W70-02095 04A

MICHEL, ROBERT L.
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

MIKULECKY, JOHN P.
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

MILLER, JAMES P.
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

MILLER, L. A.
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

MILSTEAD, C. E.
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

MISHON, V. M.
METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

MOELLER, D. H.
CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

MOLITVIN, P. V.
INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

MOREL-SEYTOUX, HUBERT J.
STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

MORRISON, JOHN I.
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

MORRISON, S. M.
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

MOSELEY, JOE C.
SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

MUKHERJEE, S. K.
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

MURPHY, GEORGE G.
INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

MURPHY, R. S.
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE,
W70-02178 05D

MYERS, LLOYD E.
CURRENT SEEPAGE REDUCTION RESEARCH,
W70-02260 04A

NEUMEYER, JOHN
PESTICIDES,
W70-02132 05G

NICHOLAS, W. R.
EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

NICHOLS, T. C., JR.
THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

NIELSEN, CHRISTIAN
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

NILSON, KAY M.
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

NORLING, RICHARD ARTHUR
A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT,
W70-02270 05G

NORMAN, V. W.
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

NORRIS, STANLEY E.
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

OERTLI, J. J.
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

ONIONS, C. A.
SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W70-02097 02J

ORY, THOMAS R.
SEEPAGE DETECTION BY REMOTE SENSING,
W70-02169 07B

OSBORNE, A. M.
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

OSTREM, GUNNAR
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

OSWALD, WILLIAM J.
EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

OTHMER, DONALD F.
EVAPORATION FOR DESALINATION,
W70-02158 03A

PACKER, MURLAND R.
SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

PAGE, C. T.
IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

PAIM, U.
DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
W70-02341 05C

IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

PALANGE, RALPH C.
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

PALMER, B. R.
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

PARARAS-CARAYANNIS, GEORGE
CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

PARKER, DENNY S.
WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

PARKER, F. L.
IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

PATMAN, J. H.
GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

PATRIC, J. H.
SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

PECHERKIN, I. A.
FORECASTING THE REWORKING OF KARSTIC SHORES OF RESERVOIRS COMPOSED OF SULFATE ROCKS,
W70-02166 08E

PELMOTER, ALBERT L.
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

PENMAN, F.
SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
W70-02425 02G

PENN, RAYMOND J.
COMMENT ON 'WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT',
W70-02375 06B

PETERSEN, Z. I.
MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

PETERSON, DEAN F.
HYDRAULICS OF LARGE BED ELEMENT CHANNELS,

W70-02070 08B

PEYTON, H. R.
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE,
W70-02113 03A

PHILLIPS, H. O.
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

PHILLIPS, JAN C.
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

PILKEY, ORRIN H.
MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

PIPES, W. O.
WASTEWATER TREATMENT,
W70-02196 05D

PLASS, WILLIAM T.
TREE SURVIVAL AND GROWTH ON FESCUE COVERED SPOIL BANKS,
W70-02211 04A

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
W70-02213 04A

PLEBUCH, RAYMOND C.
WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

POLIKARPOVA, Z. D.
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER,
W70-02432 05G

POON, CALVIN P.
SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

POPOV, I. N.
MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN),
W70-02226 02E

POSEY, F. A.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

POWERS, W. L.
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

PROKOF'YEV, G. N.
TRANSPORT VELOCITY OF SUSPENDED PARTICLES OF VARIOUS SIZES IN HORIZONTAL FLOWS (RUSSIAN),
W70-02231 02J

PROLL, E.
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS,
W70-02171 08C

PURTYMUN, WILLIAM D.
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

QUIMPO, RAPHAEL G.
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

RABIDOU, R. J.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

RASMUSSON, MARY E.
CHRONIC ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

RATHBUN, R. E.
HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE REENTRAINMENT PROCESS,
W70-02074 02J

REEHUN, M.
CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

REGINATO, ROBERT J.
CURRENT SEEPAGE REDUCTION RESEARCH,
W70-02260 04A

REISH, DONALD J.
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
W70-02360 05C

REISH, D. J.
THE EFFECTS OF HYPER- AND HYPO-CHLORINITIES ON MEMBERS OF THE WOOD-BORING GENUS LIMNORIA,
W70-02372 05C

RENTSCHLER, LOUIS C.
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA, .
W70-02051 03C

RIBEIRO, ROBERTO
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

RIEKE, HERMAN H., III.
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

RILEY, J. PAUL
SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

RISEBROUGH, ROBERT W.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

RITTER, JOHN R.
MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

ROBBINS, J. W. D.
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

ROBERTSON, E. A., JR.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

ROBERTSON, GORDON G.
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS,
W70-02133 08A

ROBERTSON, J. B.
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

ROGERS, E. H.
SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
W70-02281 08F

ROHRMAN, F. A.
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

ROLLO, J. R.
SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
W70-02094 02L

ROMBERGER, SAMUEL B.
GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

ROOKES, P. G.
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

ROSENBERG, NORMAN J.
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

ROZHDESTVENSKY, A. V.
ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

RYFFEL, J. R.
CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

SALTER, P. J.
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

SAMOILOVA, E. M.
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

SANBORN, GENE
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

SANDERS, JOHN E.
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

SARASWAT, I. P.
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

SARKAR, SWAPAN KUMAR
MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN

THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

SATO, RYUZO
PRODUCTION FUNCTIONS WITH VARIABLE ELASTICITY OF FACTOR SUBSTITUTION SOME ANALYSIS AND TESTING,
W70-02389 06B

SAUER, ELMER F.
CONSERVATION IN A NEW TOWN,
W70-02329 02J

SAUER, STANLEY P.
METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

SAUNDERS, J. W.
MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
W70-02347 05C

CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH INCREASED SILT,
W70-02348 05C

SAVAGE, E. STUART
WATER MANAGEMENT - A NEW WAY OF LIFE,
W70-02297 05G

SAVAGE, H. C.
HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

SCARATO, RUSSELL F.
TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

SCHAD, THEODORE M.
CONGRESS AND WATER RESOURCES,
W70-02160 06E

SCHICHT, RICHARD J.
GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

SCHIEBE, FRANK R.
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

SCHIEBE, F. R.
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

SCHMER, FRED A.
INVESTIGATION OF A LINEAR MODEL TO DESCRIBE HYDROLOGIC PHENOMENON OF DRAINAGE BASINS,
W70-02238 02A

SCHMIDT, F. H.
ON THE DIFFUSION OF HEATED JETS,
W70-02402 02E

SCHMIDT, K.
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

SCHMUTZ, ERVIN M.
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH,
W70-02435 03F

SCHULTZ, R. D.
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

SCHWARK, DEAN
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

SCHWARTZ, JACOB T.
LECTURES ON THE MATHEMATICAL METHOD IN ANALYTICAL ECONOMICS,
W70-02390 06A

SCOTT, C. H.
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

SCOTT, J. B.
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

SCOTT, R. C.
WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

SCOTT, WALTER E.
CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
W70-02060 02E

SEED, H. BOLTON
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

SENGER, D.
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

SENTURK, F.
MECHANICS OF BED FORMATIONS,
W70-02149 08B

SETLOW, JANE K.
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

SHANKS, W. E.
CHRONIC ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

SHAPIRO, JOSEPH
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

SHEMTOB, A.
ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

SHIH, CHIA SHUN
DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

SHUBIN, V. F.
THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

SHVEBS, G. I.
CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

SIGAFOOS, ROBERT S.
THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

SIJBESMA, R. P.
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

SIMPSON, GEORGE D.
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

SKIDMORE, E. L.
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

SLESS, J. B.
ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

SMALLEY, I. J.
THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

SMART, J. S.
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

SMITH, EUGENE B.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

SMITH, E. B.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

SMITH, MARVIN N.
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

SMITH, M. W.
CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH

INCREASED SILT,
W70-02348 05C

SMITH, R. D.
STEEL COMPANY BUILDS FLEXIBLE WASTEWATER TREATMENT SYSTEM,
W70-02176 05D

SMITH, STUART E.
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

SMITH, WINCHELL
FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

SOLZMAN, DAVID M.
WATERWAY INDUSTRIAL SITES A CHICAGO CASE STUDY,
W70-02386 06B

SOWA, EDWARD A.
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

SPROUL, OTIS J.
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

SPURGEON, J. L.
A SPECIAL CASE, THERMAL-DIGITAL SIMULATION OF WASTE HEAT DISCHARGES,
W70-02398 05B

STARITSKII, V. G.
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

STARMACH, K.
HYDROBIOLOGICAL INVESTIGATIONS ON THE IMPOUNDMENT RESERVOIR AT GOCZALKOWICE (GERMAN),
W70-02404 02H

STEFAN, HEINZ
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

STEPHENS, F. R.
SOIL-MOISTURE LEVELS IN SOME REPRESENTATIVE SOILS NEAR JUNEAU, ALASKA,
W70-02201 02G

STEPHENS, JERRY C.
GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

STEVENS, J. H.
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

SUDOL'SKIY, A. S.
WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

SURMACH, G. P.
RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

SUSTS, A. B.
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

SWEET, D. C.
PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN,
W70-02272 06A

SWOLINSKI, MALCOLM J.
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS,
W70-02422 02G

SYDKO, A. A.
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE,
W70-02441 02G

TAMAI, NOBUYUKI
HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

TANNER, WILLIAM F.
THE PARTICLE SIZE SCALE,
W70-02173 08D

TAO, LUH C.
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

THACKSTON, E. L.
IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

THOMAS, ROBERT R.
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

THREADGILL, E. DALE
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

TILTON, J. E.
THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

TODOROVIC, P.
STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

TOEBES, C.
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

TOLSTED, DAVID N.
CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

TORNAS, SVEIN
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

TORNBERG, GORDON F.
HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

TOWNSEND, J. R.
CENTRIFUGES REDUCE WATER POLLUTION,
W70-02295 05G

TRACEY, HARRY B.
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

TRASK, HARRY
PESTICIDES,
W70-02132 05G

TRESCOTT, PETER C.
GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

TSCHANNERL, GERHARD
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

TSYGANENKO, A. F.
AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

TURNER, A. K.
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

URSIC, S. J.
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

VAN EVERDINGEN, R. O.
DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

VAN HYLCKAMA, T. E. A.
WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

VAN SCHAIK, J. C.
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

VASILEVSKAYA, V. D.
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

VASILIU, ANA
INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),

W70-02368 05C

VECCHIOLI, JOHN
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

VEREEN, L. E.
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

VISOCKY, ADRIAN P.
GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

VITA-FINZI, C.
THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

VOGEL, WILLIS G.
GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

VROOMAN, HORRELL M., JR.
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

WAHISTROM, ERNEST E.
THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

WALTON, W. C.
RECHARGE FROM INDUCED STREAMBED INFILTRATION UNDER VARYING GROUNDWATER-LEVEL CONDITIONS,
W70-02263 04B

WARD, W. H.
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR,
W70-02170 08E

WATSON, E. R.
FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT,
W70-02050 03A

WEIGIE, WELDON K.
SPOIL BANK STABILITY IN EASTERN KENTUCKY,
W70-02210 08D

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

WESTERBACK, ARNE E.
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

WEYLAND, HERMAN H.
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION,
W70-02116 03A

WHEATON, ROLLAND Z.
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

WHEELER, ALWYNE
FISH-LIFE AND POLLUTION IN THE LOWER THAMES A REVIEW AND PRELIMINARY REPORT,
W70-02356 05C

WHITEHEAD, MARY E.
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

WHITLEY, I. STEPHEN
THE RESISTANCE OF TUBIFICID WORMS TO THREE COMMON POLLUTANTS,
W70-02358 05C

WHITWORTH, W. R.
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

WIEDERHOLD, J. F. A.
DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

WIEGEL, ROBERT L.
HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02E

WILHELM, F.
PRELIMINARY REPORT OF TEMPERATURE AND OXYGEN UPTAKE IN THE LAKE SCHLIERSEE IN 1956 (GERMAN),
W70-02406 02H

WILLIAMSON, JOHN A.
TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

WILLIAMS, GEORGE P., JR.
MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

WILLIAMS, J. B.
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

WILLIAMS, ROY E.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

WILSON, ALFONSO
DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

WILSON, JOHN M.
GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

WOELKE, CHARLES E.
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

WOOD, THOMAS W.
PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

WOOD, T. G.
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

WORSTELL, R. V.
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

WUNDERLICH, WALTER O.
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

YAKUSHEVSKAYA, I. V.
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

YAMANAGA, GEORGE
PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

YAROSLAVTSEV, N. A.
CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

YEVJEVICH, VUJICA
MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

YEVJEVICH, V.
STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

YORK, C. MICHAEL
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

YOSHIDA, T.
BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

YOUNG, GLADWIN E.
WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT,
W70-02376 06B

YOUNG, ROBERT A.
THE INVESTMENT DECISION FOR SEEPAGE REDUCTION,
W70-02156 06C

ZAGUSTIN, A.
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

ZAGUSTIN, K.
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

ZANEN, A.
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

ZERNEKE, K. L.
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

ZUMWALT, EUGENE V.
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS,
W70-02420 06B

ORGANIZATIONAL INDEX

AEROJET-GENERAL CORP., EL MONTE, CALIF.
FIELD OPERATION OF A MOBILE REVERSE OSMOSIS PILOT PLANT, W70-02050 03A

A NEW DESIGN CONCEPT FOR REVERSE OSMOSIS MEMBRANE CELLS, W70-02063 03A

AEROJET-GENERAL CORP., SACRAMENTO, CALIF.
RECOVERY OF METAL SALTS FROM CONCENTRATED BRINES BY CHELATION, W70-02116 03A

AGRICULTURAL RADIOISOTOPE LAB. (IRAQ) AND ALEXANDRIA UNIV. (EGYPT).
DYNAMICS OF SALINITY AND CATION EXCHANGE EQUILIBRIA IN SOME IRAQI SOILS, W70-02430 02G

AGRICULTURAL RESEARCH SERVICE, OXFORD, MISS.
SUMMARY OF RESERVOIR SEDIMENT DEPOSITION SURVEYS MADE IN THE UNITED STATES THROUGH 1965, W70-02262 02J

AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB.
CURRENT SEEPAGE REDUCTION RESEARCH, W70-02260 04A

AKADEMIYA NAUK SSSR, MOSCOW. INSTITUT GEOGRAFII.
A MAP OF ANNUAL RUNOFF OF RIVERS OF THE ALAI AND TURKESTAN RANGES (RUSSIAN), W70-02225 02A

AKADEMIYA NAUK SSSR, MOSCOW. POCHVENNYI INSTITUT.
SALINIZATION OF SOILS OF PIEDMONT PLAINS, W70-02434 02G

THE SALTING FACTORS OF IRRIGATED SOILS IN THE TURAN PLAIN, W70-02439 02G

ALASKA UNIV., COLLEGE. ARCTIC ENVIRONMENTAL ENGINEERING LAB. AND ALASKA UNIV., COLLEGE. INST. OF WATER RESOURCES.
SALINE CONVERSION AND ICE STRUCTURES FROM ARTIFICIALLY GROWN SEA ICE, W70-02113 03A

ALASKA UNIV., COLLEGE. INST. OF WATER RESOURCES.
OXIDATION DITCH WORKS WELL IN SUB-ARCTIC CLIMATE, W70-02178 05D

ALLIED RESEARCH ASSOCIATES, INC., CONCORD, MASS.
SNOW COVER DISTRIBUTION AS MAPPED FROM SATELLITE PHOTOGRAPHY, W70-02314 07B

ALL-UNION RESEARCH INST. OF WATER SUPPLY, DRAINAGE, HYDRO-ENGINEERING WORKS AND ENGINEERING HYDROGEOLOGY, MOSCOW (USSR).
MINIMUM RUNOFF OF ANGARA RIVER TRIBUTARIES (RUSSIAN), W70-02226 02E

ALL-UNION SCIENTIFIC AND RESEARCH INST. OF HYDROTECHNICS AND RECLAMATION, MOSCOW (USSR).
UTILIZATION OF SOIL MOISTURE AND GROUNDWATER BY COTTON PLANTS IN THE CASE OF SALINE GROUNDWATER, W70-02432 05G

ALL-UNION SCIENTIFIC-RESEARCH INST. OF HYDROTECHNICS AND RECLAMATION, MOSCOW (USSR).
EXPERIENCE IN ACCELERATED IRREVERSIBLE DESALINIZATION OF SOILS IN GOLODNAYA STEPPE, W70-02441 02G

AMERICAN PIPE AND CONSTRUCTION CO., MONTEREY PARK, CALIF.
DETERMINING PRESSURE SEALING CAPACITY OF PIPE GASKETS, W70-02133 08A

AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK.
COMBINED SEWER SEPARATION USING PRESSURE SEWERS. W70-02392 05G

AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK. COMMITTEE ON THERMAL POLLUTION.
BIBLIOGRAPHY ON THERMAL POLLUTION. W70-02410 05B

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON AND ARIZONA UNIV., TUCSON. DEPT. OF WATERSHED MANAGEMENT.
A CONSTANT HEAD TANK FOR RAINFALL SIMULATORS, W70-02422 02G

ARIZONA AGRICULTURAL EXPERIMENT STATION, TUCSON.
THE INVESTMENT DECISION FOR SEEPAGE REDUCTION, W70-02156 06C

ARIZONA UNIV., TUCSON.
MOTIVATION OF SCIENTISTS AND ENGINEERS, W70-02148 09B

A SYSTEM MODEL FOR STREAM POLLUTION MANAGEMENT, W70-02270 05G

ARIZONA UNIV., TUCSON. DEPT. OF AGRONOMY.
DON'T STRESS YOUR WHEAT FOR WATER, W70-02436 03F

ARIZONA UNIV., TUCSON. DEPT. OF WATERSHED MANAGEMENT.
CRESTED WHEATGRASS AND WINTERFAT EMERGENCE UNDER SIMULATED DROUTH, W70-02435 03F

ARIZONA WATER RESOURCES RESEARCH CENTER, TUCSON.
A NEW METHOD OF INSTALLING PLASTIC MEMBRANES, W70-02274 04A

ARKANSAS UNIV., FAYETTEVILLE. WATER RESOURCES RESEARCH CENTER.
VIRUS MOVEMENT IN GROUNDWATER SYSTEMS, W70-02240 05B

BATTELLE MEMORIAL INST., COLUMBUS, OHIO.
WATER RESOURCES SYSTEMS ANALYSIS--AN OVERVIEW, W70-02151 06A

PROGRESS REPORT ON A DYNAMIC MODEL OF THE ECONOMY OF THE SUSQUEHANNA RIVER BASIN, W70-02272 06A

BATTELLE-NORTHWEST, RICHLAND, WASH.
EFFECTIVE MANAGEMENT OF WATER, LAND, AND AIR RESOURCES, W70-02168 06E

A SPECIAL CASE, THERMAL DIGITAL SIMULATION OF WASTE HEAT DISCHARGES, W70-02398 05B

BATTELLE-NORTHWEST, RICHLAND, WASH. PACIFIC NORTHWEST LAB.
THERMAL MODIFICATION OF RIVER WATER QUALITY, W70-02408 07C

BEDFORD INST., DARTMOUTH (NOVA SCOTIA). ATLANTIC OCEANOGRAPHIC LAB.
MID-ATLANTIC RIDGE NEAR 45 DEGREE N. IV. WATER PROPERTIES IN THE MEDIAN VALLEY, W70-02302 02K

BETHLEHEM STEEL CORP., PA. HOMER RESEARCH LAB.
BIOLOGICAL OXIDATION OF COKE PLANT WEAK AMMONIA LIQUOR, W70-02181 05D

BETZ LABS., INC., TREVOSE, PA. COOLING WATER SERVICES.
COOLING WATER CHEMICAL TREATMENTS, W70-02294 05D

BOLIVAR LABS., SALISBURY (AUSTRALIA).
FURTHER PLANKTONIC ALGAE OF AUCKLAND SEWAGE TREATMENT PONDS AND OTHER WATERS, W70-02304 05C

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF ZOOLOGY.
EPIBENTHIC ALGAL PRODUCTION AND COMMUNITY RESPIRATION IN THE SEDIMENTS OF MARION LAKE, W70-02244 02H

BRITISH MUSEUM OF NATURAL HISTORY, LONDON. DEPT. OF ZOOLOGY.
FISH-LIFE AND POLLUTION IN THE LOWER THAMES A REVIEW AND PRELIMINARY REPORT, W70-02356 05C

BROWN, BOVERI AND CO. LTD., BADEN (SWITZERLAND).
STABILITY OF AC NETWORKS IN ASSOCIATION WITH HVDC INSTALLATIONS, W70-02171 08C

BUILDING RESEARCH STATION, WATFORD (ENGLAND) AND INSTITUTE OF GEOLOGICAL SCIENCES, LONDON (ENGLAND).
GEOTECHNICAL ASSESSMENT OF A SITE AT MUNDFORD, NORFOLK, FOR A LARGE PROTON ACCELERATOR, W70-02170 08E

BUNDESANSTALT FUER WASSERBAU, KARLSRUHE (WEST GERMANY).
A PROGRAM TO CALCULATE THE CHANGES OCCURRING IN THE BOTTOM AND THE WATERSHED OF A RIVER CARRYING A BED LOAD (FRENCH), W70-02103 08B

BUREAU OF LAND MANAGEMENT, WASHINGTON, D.C.
THE LAST FRONTIER AMERICA'S ARID PUBLIC LANDS, W70-02420 06B

BUREAU OF RECLAMATION, DENVER, COLO.
FIELD TESTS OF CRACK AND JOINT SEALING COMPOUNDS IN CONCRETE CANAL LININGS--INTERIM REPORT, W70-02137 08G

COMPREHENSIVE PLANNING IS IT SUFFICIENT, W70-02153 06B

EXPERIMENTAL STUDY AND ANALYSIS OF DRAFT-TUBE SURGING, W70-02157 08C

BUREAU OF RECLAMATION, SACRAMENTO, CALIF.
GEOLOGIC STUDIES AT ARBUCKLE DAM, MURRAY COUNTY, OKLAHOMA, W70-02131 08E

BUREAU OF RECLAMATION, WASHINGTON, D.C.
ACQUISITION OF WATER FROM FEDERAL RECLAMATION PROJECTS FOR INDUSTRIAL AND COMMUNITY DEVELOPMENT, W70-02167 03E

BUREAU OF SPORT FISHERIES AND WILDLIFE, COLUMBIA, MO. FISH-PESTICIDE RESEARCH LAB.
EFFECTS OF DICHLOBENIL ON TWO FISHPOND ENVIRONMENTS, W70-02359 05C

CHRONIC ORAL DDT TOXICITY IN JUVENILE COHO AND CHINOOK SALMON,
W70-02362 05C

BUREAU OF THE BUDGET, WASHINGTON, D.C.
INTERBASIN WATER TRANSFERS--ECONOMIC ISSUES AND IMPACTS,
W70-02152 06D

BURNS AND ROE, INC., ORADELL, N.J.
COOLING TOWER APPLICATIONS IN POWER CYCLE DESIGN,
W70-02396 05D

CALIFORNIA INST. OF TECH., PASADENA.
THE SEISMIC EVENTS AT KOYNA DAM,
W70-02146 08A

CALIFORNIA STATE COLL., LONG BEACH. DEPT. OF BIOLOGY.
AN ECOLOGICAL STUDY OF THE POLYCHAETOUS ANNELIDS ASSOCIATED WITH FOULING MATERIAL IN LOS ANGELES HARBOR WITH SPECIAL REFERENCE TO POLLUTION,
W70-02360 05C

THE EFFECTS OF HYPER- AND HYPO-CHLORINITIES ON MEMBERS OF THE WOOD-BORING GENUS LIMNORIA,
W70-02372 05C

CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
APPROACH TO CLASSIFYING ROCK FOR TUNNEL LINER DESIGN,
W70-02145 08E

CALIFORNIA UNIV., BERKELEY AND UTAH STATE UNIV., LOGAN.
CHARACTERISTICS OF ROCK MOTIONS DURING EARTHQUAKES,
W70-02159 08E

CALIFORNIA UNIV., BERKELEY.
PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY,
W70-02382 06B

HORIZONTAL SURFACE DISCHARGE OF WARM WATER JETS,
W70-02412 02F

CALIFORNIA UNIV., BERKELEY. SANITARY ENGINEERING RESEARCH LAB.
EUTROPHICATION TRENDS IN THE UNITED STATES--A PROBLEM,
W70-02253 05C

CALIFORNIA UNIV., DAVIS. DEPT. OF GEOLOGY AND CALIFORNIA UNIV., BODEGA BAY. BODEGA MARINE LAB.
PALEOCLIMATOLOGY AND THE RELATIVE STABILITY OF FELDSPAR MINERALS UNDER ATMOSPHERIC CONDITIONS,
W70-02339 02J

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF AGRONOMY AND CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOILS AND PLANT NUTRITION.
ATRIPLEX POLYCARPA II. GERMINATION AND GROWTH IN WATER CULTURES CONTAINING HIGH LEVELS OF BORON,
W70-02438 02I

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOILS AND PLANT NUTRITION.
THE SIGNIFICANCE OF THE EXTERNAL WATER POTENTIAL AND OF SALT TRANSPORT TO WATER RELATIONS IN PLANTS,
W70-02426 02G

CALIFORNIA UNIV., SANTA BARBARA.
PUBLIC POLICY ISSUES IN WEATHER MODIFICATION,
W70-02129 06B

CAMP, DRESSER AND MCKEE, BOSTON, MASS.
REPORT ON DEVELOPMENT OF A MATHEMATICAL MODEL FOR MINIMIZING CONSTRUCTION COSTS IN WATER POLLUTION CONTROL.
W70-02258 05G

CLEMSON UNIV., S.C. WATER RESOURCES RESEARCH INST.
FEASIBILITY STUDY OF ELECTRICAL GEOPHYSICAL METHODS IN THE DETERMINATION OF SUBSURFACE HYDROGEOLOGIC ENVIRONMENTS IN THE PIEDMONT AREA OF SOUTH CAROLINA,
W70-02241 07B

COCHRANE PRODUCTS CRANE CO., KING OF PRUSSIA, PA.
TERTIARY TREATMENT BY MICROSTRAINING,
W70-02186 05D

COLORADO STATE UNIV., FORT COLLINS.
MISCONCEPTIONS IN HYDROLOGY AND THEIR CONSEQUENCES,
W70-02313 02A

BACTERIAL RESPONSE TO THE SOIL ENVIRONMENT,
W70-02442 05B

COLORADO STATE UNIV., FORT COLLINS. DEPT OF CIVIL ENGINEERING.
STATISTICAL DISCRIMINATION OF CHANGE IN DAILY RUNOFF,
W70-02330 02E

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
STOCHASTIC PROCESS OF PRECIPITATION,
W70-02298 02B

COLORADO UNIV., BOULDER AND GEOLOGICAL SURVEY, DENVER, COLO.
THE MORPHOLOGY AND CHRONOLOGY OF A LANDSLIDE NEAR DILLON DAM, DILLON, COLORADO,
W70-02172 08D

COLORADO UNIV., BOULDER.
MESHING WATERSHED DEVELOPMENT WITH RIVER BASIN DEVELOPMENT,
W70-02379 06A

COLUMBIA UNIV., DOBBS FERRY, N.Y. HUDSON LABS. AND RENSSELAER POLYTECHNIC INST., TROY, N.Y. DEPT OF GEOLOGY.
POSITION OF REGIONAL CARBONATE/NONCARBONATE BOUNDARY IN NEARSHORE SEDIMENTS ALONG A COAST POSSIBLE CLIMATIC INDICATOR,
W70-02098 02L

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, MELBOURNE (AUSTRALIA).
SOIL AND SALINITY FACTORS IN IRRIGATION AND DRAINAGE OF MALLEE LANDS,
W70-02425 02G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ADELAIDE (AUSTRALIA). DEPT. OF SOILS.
PRELIMINARY STUDIES OF THE ROLE OF NASUTITERMES EXITIOSUS (HILL) IN THE CYCLING OF ORGANIC MATTER IN A YELLOW PODZOLIC SOIL UNDER DRY SCLEROPHYLL FOREST IN SOUTH AUSTRALIA,
W70-02427 02G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ADELAIDE (AUSTRALIA). DIV. OF SOILS.
THE REDISTRIBUTION OF THE MORE SOLUBLE CHEMICAL ELEMENTS ASSOCIATED WITH SOILS AS INDICATED BY ANALYSIS OF RAIN-WATER, SOILS AND PLANTS,
W70-02431 02A

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, GRIFFITH (AUSTRALIA). DIV. OF SOILS.
SALTING IN IRRIGATION AREAS,
W70-02433 02G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, ADELAIDE (AUSTRALIA). DIV. OF SOILS.
WATER REPELLENT SANDS,
W70-02440 02G

CONNECTICUT UNIV., STORRS. COLL. OF AGRICULTURE.
EFFECTS OF FLUCTUATIONS OF LEAD, TEMPERATURE, AND DISSOLVED OXYGEN ON THE GROWTH OF BROOK TROUT,
W70-02346 05C

CORPS OF ENGINEERS, ANCHORAGE, ALASKA.
FLOOD PLAIN INFORMATION, KUSKOKWIM RIVER, BETHEL, ALASKA.
W70-02312 04A

CORPS OF ENGINEERS, FAIRBANKS, ALASKA.
FLOOD PLAIN INFORMATION, CHENA RIVER, FAIRBANKS, ALASKA.
W70-02089 04A

CORPS OF ENGINEERS, LOS ANGELES, CALIF.
FLOOD PLAIN INFORMATION, MOJAVE RIVER (VICINITY OF VICTORVILLE), SAN BERNARDINO COUNTY, CALIFORNIA.
W70-02085 04A

FLOOD PLAIN INFORMATION, SANTA YNEZ RIVER, SANTA BARBARA COUNTY, CALIFORNIA.
W70-02087 04A

CORPS OF ENGINEERS, SACRAMENTO, CALIF.
FLOOD PLAIN INFORMATION, UPPER TRUCKEE RIVER, SOUTH LAKE TAHOE, CALIFORNIA.
W70-02086 04A

CORPS OF ENGINEERS, ST. LOUIS, MO.
FLOOD PLAIN INFORMATION, FLAT RIVER AREA, MISSOURI.
W70-02088 04A

CORPS OF ENGINEERS, VICKSBURG, MISS.
CANAL SHOALING STUDIES,
W70-02108 08B

DEPARTMENT OF AGRICULTURE, LETHBRIDGE (ALBERTA). RESEARCH STATION.
INFLUENCE OF ADSORBED SODIUM AND GYPSUM CONTENT ON PERMEABILITY OF GLACIAL TILL SOILS,
W70-02126 02G

DEPARTMENT OF AGRICULTURE, RALEIGH, N.C.
THE STATE OF ECONOMIC DATA,
W70-02378 06B

DEPARTMENT OF ENERGY, MINES AND RESOURCES, CALGARY (ALBERTA). INLAND WATERS BRANCH.
DEGREE OF SATURATION WITH RESPECT TO CALCITE, DOLOMITE, AND GYPSUM FOR SOME THERMAL AND MINERAL SPRINGS IN THE SOUTHERN ROCKY MOUNTAINS, ALBERTA AND BRITISH COLUMBIA,
W70-02301 02K

DEPARTMENT OF NATIONAL HEALTH AND WELFARE, EDMONTON (ALBERTA). PUBLIC HEALTH ENGINEERING DIV.
PROPOSED DESIGN CRITERIA FOR WASTEWATER LAGOONS IN ARCTIC AND SUB-ARCTIC REGIONS,
W70-02183 05D

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, WELLINGTON (NEW ZEALAND). SOILS BUREAU.
SOME FEATURES OF ANTARCTIC SOILS AND THEIR RELATION TO OTHER DESERT SOILS,
W70-02437 02C

DEPARTMENT OF THE NAVY, WASHINGTON, D.C.
THE EFFECT OF SEEPAGE LOSSES ON STREAM REGIMEN,
W70-02273 04A

DIRECCAO GERAL DOS SERVICOS HIDRAULICOS, LISBON (PORTUGAL) AND LABORATORIO NACIONAL DE ENGENHARIA CIVIL, LISBON (PORTUGAL).
SEDIMENTATION AND SEDIMENTATION PROBLEMS OF THE MONDEGO RIVER,

W70-02107 08B

DIVISION OF ISOTOPES DEVELOPMENT (AEC), WASHINGTON, D.C. AND ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO.
THE PRACTICALITY OF USING ATOMIC RADIATION FOR WASTEWATER TREATMENT,
W70-02185 05D

DORR-OLIVER, INC., STAMFORD, CONN.
CENTRIFUGATION OF WASTE SLUDGES,
W70-02199 05D

DOW CHEMICAL CO., MIDLAND, MICH. PLASTICS DEPT. AND DOW CHEMICAL CC., PLAQUEMINE, LA. RESEARCH AND DEVELOPMENT DIV.
CHARACTERISTICS OF THERMOPLASTIC AND ELASTOMERIS LINERS,
W70-02275 04A

DRAVC CORP., PITTSBURGH, PA. DEPT. OF WATER AND WASTE TREATMENT.
WATER MANAGEMENT - A NEW WAY OF LIFE,
W70-02297 05G

DREXEL INST. OF TECH. PHILADELPHIA, PA. AND STANFORD UNIV., CALIF.
KINETICS OF METHANE FERMENTATION IN ANAEROBIC TREATMENT,
W70-02192 05D

DUKE UNIV., DURHAM, N.C. DEPT. OF GEOLOGY AND DUKE UNIV., BEAUFORT, N.C. MARINE LAB.
MINERALOGY OF THE SAND SIZE CARBONATE FRACTION OF SOME RECENT MARINE TERRIGENOUS AND CARBONATE SEDIMENTS,
W70-02338 02L

DURHAM UNIV. (ENGLAND). DEPT. OF GEOGRAPHY.
THE SOILS OF THE TRUCIAL STATES CLASSIFICATION AND CAPABILITY,
W70-02423 02G

EAST BAY MUNICIPAL UTILITY DISTRICT, OAKLAND, CALIF.
COMPARISON TESTS OF STEEL PIPE COATINGS,
W70-02140 08G

EASTERN ILLINOIS UNIV., CHARLESTON. DEPT. OF ZOOLOGY.
THE RESISTANCE OF TUBIFICID WORMS TC THREE CCMMCN POLLUTANTS,
W70-02358 05C

ECONOMIC RESEARCH SERVICE, WASHINGTON, D.C. NATURAL RESOURCE ECONOMICS DIV. AND MISSOURI AGRICULTURAL EXPERIMENT STATION, COLUMBIA.
AN ECONOMETRIC MODEL FOR PREDICTING WATER-ORIENTED OUTDOOR RECREATION DEMAND,
W70-02194 06D

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND).
MECHANISMS OF SELF-PURIFICATION IN FLOWING WATERS (EDGARDO BALDI MEMORIAL LECTURE) (GERMAN),
W70-02405 05B

ELGIN INTERNATIONAL INC., ILL.
SUL-BISUL ION EXCHANGE PROCESS FIELD EVALUATION ON BRACKISH WATERS,
W70-02047 03A

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, HELENA, MONT.
WATER QUALITY STANDARDS SUMMARY.
W70-02069 05G

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, WASHINGTON, D.C.
OPERATION AND MAINTENANCE OF MUNICIPAL WASTE TREATMENT PLANTS,
W70-02180 05D

PROJECTS OF THE INDUSTRIAL POLLUTION CONTROL BRANCH (FEDERAL WATER POLLUTICN CONTROL ADMINISTRATION),
W70-02285 05G

FISH AND WILDLIFE SERVICE, BOZEMAN, MONT. COOPERATIVE FISHERY UNIT MONTANA STATE UNIV., BOZEMAN AND OKLAHOMA STATE UNIV., STILLWATER. AQUATIC BIOLOGY LAB.
LONG-TERM TOXICITY BIOASSAY OF OIL REFINERY EFFLUENTS,
W70-02355 05C

FISHERIES RESEARCH BOARD OF CANADA, ST. ANDREWS (NEW BRUNSWICK). BIOLOGICAL STATICN.
FISH LOSSES AFTER FOREST SPRAYING WITH INSECTICIDES IN NEW BRUNSWICK, 1952-62, AS SHOWN BY CAGED SPECIMENS AND OTHER CBSERVATIONS,
W70-02344 05C

FISHERIES RESEARCH BOARD OF CANADA, ST. ANDREWS (NEW BRUNSWICK).
MASS MORTALITIES AND BEHAVIOR OF BROOK TROUT AND JUVENILE ATLANTIC SALMON IN A STREAM AND JUVENILE ATLANTIC SALMON IN A STREAM POLLUTED BY AGRICULTURAL PESTICIDES,
W70-02347 05C

FISHERIES RESEARCH BOARD OF CANADA, ST. ANDREWS (NEW BRUNSWICK). BIOLOGICAL STATION.
CHANGES IN A STREAM POPULATION OF TROUT ASSOCIATED WITH INCREASED SILT,
W70-02348 05C

EFFECTS ON WILD YOUNG SALMON OF SPRAYING DDT OVER NEW BRUNSWICK FORESTS,
W70-02351 05C

FLORIDA STATE UNIV., TALLAHASSEE.
THE PARTICLE SIZE SCALE,
W70-02173 08D

FLORIDA STATE UNIV., TALLAHASSEE. DEPT. OF OCEANOGRAPHY.
A FLORIDA SABELLARIIDAE REEF AND ITS EFFECT ON SEDIMENT DISTRIBUTION,
W70-02334 02L

FOREST SERVICE (USDA), BEREA, KY. NORTHEASTERN FOREST EXPERIMENT STATION.
FOREST ZONE HELPS MINIMIZE FLOODING IN THE DRIFTLESS AREA,
W70-02203 04C

SIMPLE PRACTICES ALONG FOREST EDGE REDUCE UPLAND RUNOFF,
W70-02204 04D

CHART HOLDER USES OLD TYPEWRITER PARTS,
W70-02205 07C

GRASSES AND LEGUMES FOR COVER ON ACID STRIP-MINE SPOILS,
W70-02206 04C

ACIDITY AND PLANT-AVAILABLE PHOSPHORUS IN STRATA OVERLYING COAL SEAMS,
W70-02208 04D

MANGANESE TOXICITY OF LEGUMES SEEDED IN KENTUCKY STRIP-MINE SPOILS,
W70-02209 05C

SPOIL BANK STABILITY IN EASTERN KENTUCKY,
W70-02210 08D

MATCH ADDITIVE TO SOIL TYPES FOR BEST STABILIZATION,
W70-02214 04A

EROSION FROM ABANDONED COAL-HAUL ROADS,
W70-02215 04D

HYDROLOGY OF CONTOUR STRIP MINES IN THE APPALACHIAN REGION OF THE UNITED STATES,
W70-02217 04C

FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION.
NOCTURNAL RADIATION LOSS ESTIMATES FCR A FOREST CANOPY,
W70-02200 02D

FOREST SERVICE (USDA), KINGSTON, PA. NORTHEASTERN FCREST EXPERIMENT STATION.
RESPONSE OF CROWNVETCH PLANTED ON ANTHRACITE BREAKER REFUSE,
W70-02212 04A

FOREST SERVICE (USDA), OXFORD, MISS. SOUTHERN FOREST EXPERIMENT STATION.
HYDROLOGIC EFFECTS OF PRESCRIBED BURNING ON ABANDONED FIELDS IN NORTHERN MISSISSIPPI,
W70-02207 04D

FOREST SERVICE (USDA), PORTLAND OREG. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION.
SOIL-MOISTURE LEVELS IN SCME REPRESENTATIVE SCILS NEAR JUNEAU, ALASKA,
W70-02201 02G

FOREST SERVICE (USDA), PORTLAND, OREG. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION.
POTENTIAL EVAPOTRANSPIRATION AND CLIMATE IN ALASKA BY THORNTHWAITE'S CLASSIFICATION,
W70-02202 02D

FOREST SERVICE (USDA), PRINCETON, W. VA. NORTHEASTERN FOREST EXPERIMENT STATION.
TREE SURVIVAL AND GROWTH ON FESCUE COVERED SPOIL BANKS,
W70-02211 04A

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY,
W70-02213 04A

FOREST SERVICE (USDA), UPPER DARBY, PA. NORTHEASTERN FOREST EXPERIMENT STATION.
FOREST SERVICE RECLAMATION RESEARCH,
W70-02216 04A

GEOLCGICAL INST., GRONINGEN (NETHERLANDS).
SETTLING CONVECTION AND GRAIN-SIZE ANALYSIS,
W70-02333 02J

GEOLOGICAL SURVEY, ALBUQUERQUE, N. MEX. GEOLOGICAL SURVEY, ANCHORAGE, ALASKA AND GEOLOGICAL SURVEY, SAN JUAN, PUERTO RICO.
REDUCTION OF FLUORESCENCE OF TWO TRACER DYES BY CONTACT WITH A FINE SEDIMENT,
W70-02080 07B

GEOLOGICAL SURVEY, AUSTIN, TEX.
GROUNDWATER RESOURCES OF KIMBLE COUNTY, TEXAS,
W70-02091 02F

GEOLOGICAL SURVEY, BATON ROUGE, LA.
SALT-WATER ENCROACHMENT IN AQUIFERS OF THE BATON ROUGE AREA, LOUISIANA,
W70-02094 02L

GEOLOGICAL SURVEY, COLUMBUS, OHIO.
CORRELATION OF CARBONATE ROCK UNITS IN NORTHWEST OHIO BY NATURAL GAMMA LOGGING,
W70-02079 07B

GEOLOGICAL SURVEY, DENVER, COLO.
NOTES ON THE GEOLOGY AND PALEOHYDROLOGY OF THE BOULDER CITY

PLUTON, SOUTHERN NEVADA,
W70-02073 02F

DETERMINATION OF TRACES OF SILVER IN WATERS BY ANION EXCHANGE AND ATOMIC ABSORPTION SPECTROPHOTOMETRY,
W70-02099 02K

GEOLOGICAL SURVEY, FORT COLLINS, COLO.
HYDRAULIC EQUIVALENCE OF MINERALS WITH A CONSIDERATION OF THE ENTRAINMENT PROCESS,
W70-02074 02J

MOTION OF SINGLE PARTICLES IN SAND CHANNELS,
W70-02320 02J

GEOLOGICAL SURVEY, HONOLULU, HAWAII.
PRELIMINARY REPORT ON THE WATER RESOURCES ON THE LAHAINA DISTRICT, MAUI,
W70-02065 03B

GEOLOGICAL SURVEY, HURON, S. DAK.
EFFECTS OF RESERVOIR FILLING ON A BURIED AQUIFER OF GLACIAL ORIGIN, CAMPBELL COUNTY, SOUTH DAKOTA,
W70-02081 03B

GEOLOGY AND WATER RESOURCES OF BEADLE COUNTY, SOUTH DAKOTA PART 2, WATER RESOURCES,
W70-02306 02F

BASIC HYDROLOGIC DATA, FOR A PART OF THE BIG SIOUX DRAINAGE BASIN, EASTERN SOUTH DAKOTA,
W70-02317 02F

GEOLOGICAL SURVEY, IDAHO FALLS, IDAHO.
BEHAVIOR OF XENON 133 GAS AFTER INJECTION UNDERGROUND,
W70-02072 05A

GEOLOGICAL SURVEY, JACKSONVILLE, FLA.
PRODUCTION AND UTILIZATION OF WATER IN THE METROPOLITAN AREA OF JACKSONVILLE, FLORIDA,
W70-02092 03D

GEOLOGICAL SURVEY, LAWRENCE, KANS.
EFFECT OF IRRIGATION ON THE CHEMICAL QUALITY OF LOW STREAMFLOW ADJACENT TO CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
W70-02093 05C

GEOLOGICAL SURVEY, LUBBOCK, TEX.
WATER USE BY SALTCEDAR WITH MANY FACTORS,
W70-02134 03B

GEOLOGICAL SURVEY, MENLO PARK, CALIF.
BEACH LAMINATION NATURE AND ORIGIN,
W70-02057 02L

MEASUREMENT OF WATER FLOW AND SUSPENDED-SEDIMENT LOAD, BOLINAS LAGOON, BOLINAS, CALIFORNIA,
W70-02082 02L

GEOLOGICAL SURVEY, PORTLAND, OREG.
SEDIMENT TRANSPORT IN STREAMS IN THE UMPQUA RIVER BASIN, OREGON,
W70-02097 02J

WATER-RESOURCES APPRAISAL OF CRATER LAKE NATIONAL PARK, OREGON,
W70-02293 02E

GEOLOGICAL SURVEY, SANTA FE, N. MEX. AND GEOLOGICAL SURVEY, ALBUQUERQUE, N. MEX.
DEVELOPMENT OF GROUNDWATER SUPPLIES ON THE PAJARITO PLATEAU, LOS ALAMOS COUNTY, NEW MEXICO,
W70-02076 03B

GEOLOGICAL SURVEY, TACOMA, WASH.
CHARACTERISTICS OF STREAMFLOW IN THE COLVILLE RIVER BASIN, STEVENS COUNTY, WASHINGTON,
W70-02060 02E

TEMPERATURE ANALYSIS OF A STREAM,
W70-02062 02E

SOIL-MOISTURE LOSSES IN THE UPPER THREE INCHES OF SOIL, CIBECUE RIDGE, ARIZONA,
W70-02083 02G

GEOLOGICAL SURVEY, TALLAHASSEE, FLA.
HYDROLOGIC CONDITIONS DURING 1967 IN DADE COUNTY, FLORIDA,
W70-02318 02E

GEOLOGICAL SURVEY, TRENTON, N.J. AND NEW JERSEY STATE DEPT. OF CONSERVATION AND ECONOMIC DEVELOPMENT. WATER POLICY AND SUPPLY DIV.
OCCURRENCE AND MOVEMENT OF GROUNDWATER IN THE BRUNSWICK SHALE AT A SITE NEAR TRENTON, NEW JERSEY,
W70-02077 03B

GEOLOGICAL SURVEY, WASHINGTON, D.C.
GROUNDWATER LEVELS IN THE UNITED STATES, 1962-66, NORTH-CENTRAL STATES,
W70-02044 07C

VARIATIONS IN LOW-WATER STREAMBED ELEVATIONS AT SELECTED STREAM-GAGING STATIONS IN NORTHWESTERN CALIFORNIA,
W70-02045 07C

WATER QUALITY AND DISCHARGE OF STREAMS IN THE LEHIGH RIVER BASIN, PENNSYLVANIA,
W70-02052 05B

FEASIBILITY STUDY OF THE USE OF THE ACOUSTIC VELOCITY METER FOR MEASUREMENT OF NET OUTFLOW FROM THE SACRAMENTO-SAN JOAQUIN DELTA,
W70-02053 07B

WATER LOAD OF URANIUM, RADIUM, AND GROSS BETA ACTIVITY AT SELECTED GAGING STATIONS, WATER YEAR 1960-61,
W70-02054 05B

WATER RESOURCES OF CLARK, CLEVELAND, AND DALLAS COUNTIES, ARKANSAS,
W70-02055 03B

THE TIME INTERVAL BETWEEN STABILIZATION OF ALPINE GLACIAL DEPOSITS AND ESTABLISHMENT OF TREE SEEDLINGS,
W70-02075 07B

APPLICATION OF POISSON DISTRIBUTION TO FLOOD SERIES,
W70-02078 02E

SEEPAGE TESTS IN L-D1 BORROW CANAL AT LAKE OKEECHOBEE, FLORIDA,
W70-02095 04A

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 3 AND 4.
W70-02114 07C

QUALITY OF SURFACE WATERS OF THE UNITED STATES, 1964 -- PARTS 1 AND 2.
W70-02115 07C

WATER QUALITY IN THE DELAWARE ESTUARY FOR TWO YEARS OF DROUGHT 1965 AND 1966 FROM TRENTON, NEW JERSEY TO REEDY ISLAND, DELAWARE,
W70-02119 02L

DISCHARGE TO THE SEA FROM THE SHORES OF THE CONTERMINOUS UNITED STATES, ALASKA, AND PUERTO RICO,
W70-02120 02E

FLOODS ON LEVISA FORK IN VICINITY OF PAINTSVILLE, KENTUCKY,
W70-02121 02E

FLOODS IN UPPER MILLSTONE RIVER BASIN IN VICINITY OF HIGHTSTOWN, NEW JERSEY,
W70-02122 02E

FLOODS ON SUSQUEHANNA RIVER AT ONEONTA, NEW YORK,
W70-02123 02E

LABORATORY THEORY AND METHODS FOR SEDIMENT ANALYSIS,
W70-02316 02J

DISSIPATION OF HEAT FROM A THERMALLY LOADED STREAM,
W70-02414 05B

GEORGIA INST. OF TECH., ATLANTA.
INSTRUMENTS FOR MEASURING ATTITUDE TOWARD A COMMUNITY WATER ISSUE,
W70-02279 06B

GIDROMETEOROLOGICHESKII INSTITUT, ODESSA (USSR).
CONTROLLING SURFACE RUNOFF USING A PATCH METHOD OF STUBBLE MULCHING (RUSSIAN),
W70-02229 03F

GOODRICH (B. F.) AEROSPACE AND DEFENSE PRODUCTS CO., AKRON, OHIO.
BIOCIDAL RUBBER FOR WATER RECLAMATION SYSTEMS,
W70-02059 03A

GULF COAST MARINE HEALTH SCIENCES LAB.
STUDY OF CHLORINATED PESTICIDES IN OYSTERS AND ESTUARINE ENVIRONMENT OF THE MOBILE BAY AREA,
W70-02100 05B

GULF GENERAL ATOMIC, INC., SAN DIEGO, CALIF.
STUDY OF REJECTION OF VARIOUS SOLUTES BY REVERSE OSMOSIS MEMBRANES,
W70-02048 03A

HARVARD UNIV., CAMBRIDGE, MASS.
ECONOMIC DECISION FRAMEWORK FOR THE EFFICIENT USE OF DATA SOURCES,
W70-02271 07B

HAVENS AND EMERSON, CLEVELAND, OHIO.
TREATMENT OF COMBINED SEWER OVERFLOWS AND SURFACE WATERS AT CLEVELAND, OHIO,
W70-02195 05D

HAWAII UNIV., HONOLULU AND COAST AND GEODETIC SURVEY, HONOLULU, HAWAII.
CATALOG OF TSUNAMIS IN ALASKA,
W70-02289 02L

HERCULES, INC., WILMINGTON, DEL. ENVIRONMENTAL SERVICES DIV.
PLANNING FOR INDUSTRIAL WASTEWATER TREATMENT,
W70-02197 05D

HRB-SINGER, INC., STATE COLLEGE, PA. RADIOMETRICS LAB.
SEEPAGE DETECTION BY REMOTE SENSING,
W70-02169 07B

HYDROMETEOROLOGICAL SERVICE OF THE USSR, MOSCOW.
SOME RELATIONSHIPS BETWEEN FIXED AND MEAN DAILY MAXIMUM DISCHARGES OF RAINFALL AND FLOODS IN THE BASIN OF THE UPPER VOLGA RIVER (RUSSIAN),
W70-02221 02A

IBM WATSON RESEARCH CENTER, YORKTOWN HEIGHTS, N.Y.
TOPOLOGICAL PROPERTIES OF CHANNEL NETWORKS,
W70-02101 02J

IDAHO OPERATIONS OFFICE (AEC), IDAHO FALLS. HEALTH SERVICES LAB.
INJECTION OF GAS INTO THE LITHOSPHERE AT THE NATIONAL REACTOR TESTING STATION.
W70-02321 05B

IDAHO UNIV., MOSCOW.
FACTORS AFFECTING INFILTRATION AND RECHARGE IN A LOESS COVERED BASIN,
W70-02154 04B

A NOTE ON ADMINISTERED PRICES WITH FLUCTUATING DEMAND,
W70-02388 06B

IDAHO UNIV., MOSCOW. ENGINEERING EXPERIMENT STATION AND AGRICULTURAL RESEARCH SERVICE, KIMBERLY, IDAHO. SNAKE RIVER RESEARCH CENTER.
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,
W70-02179 07B

ILLINOIS STATE WATER SURVEY, URBANA.
EFFECT OF HOUSING SHAPE ON THE CATCH OF RECORDING GAGES,
W70-02102 07B

PLANNING WATER FOR 2000 A D,
W70-02155 06B

GROUNDWATER RESOURCES OF THE BURIED MAHOMET BEDROCK VALLEY,
W70-02305 02F

ILLINOIS UNIV., URBANA. WATER RESOURCES CENTER.
WATER PRICING THEORY AND PRACTICE IN ILLINOIS,
W70-02391 06C

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, LONDON, (ENGLAND).
THE APPLICATION OF ENGINEERING GEOLOGY IN THE REGIONAL DEVELOPMENT OF NORTHERN AND CENTRAL IRAN,
W70-02162 08E

INDIAN COUNCIL OF AGRICULTURAL RESEARCH, NEW DELHI AND PUNJAB AGRICULTURE UNIVERSITY, HISSAR (INDIA).
QUALITY OF IRRIGATION WATER,
W70-02429 03C

INDIAN INST. OF TECH., KHARAGPUR. DEPT. OF GEOLOGY AND GEOPHYSICS.
MORPHOLOGY, STRUCTURE, AND EVOLUTION OF A CHANNEL ISLAND IN THE BARAKAR RIVER, BARAKAR, WEST BENGAL,
W70-02331 02J

INSTITUT D'AMENAGEMENT ET D'ECONOMIE DE L'EAU, WARSAW (POLAND).
THE INFLUENCE OF EROSION BELOW CHUTES ON THE CONDITIONS OF NAVIGATION (FRENCH),
W70-02106 08B

INSTITUT PO PROEKTIROVANIIU PREDPRIIATII NIKELEVOI PROMYSHLENNOSTI, LENINGRAD (USSR).
INVESTIGATIONS OF THE RELATIONSHIP BETWEEN SURFACE WATERS AND FISSURE-KARSTIC GROUNDWATERS OF THE AY RIVER BASIN (RUSSIAN),
W70-02220 02A

INSTITUTE OF HYDROTECHNICAL RESEARCH, BUCHAREST (RUMANIA).
SOME ASPECTS CONCERNING THE DISCHARGE OF WATERS FROM ELECTRIC POWER PLANTS USED IN THE TRANSPORT OF ASHES (FRENCH),
W70-02403 05B

INSTITUTUL DE MEDICINA SI FARMACIA, IASI (RUMANIA). CATEDRA DE IGIENA.
THE ACTION OF THE RESIDUAL WATERS OF AN ANTIBIOTIC PLANT ON THE PLANKTON AND BENTHOS OF THE RECEPTOR RIVER (IN ROMANIAN),
W70-02366 05C

FOLLOW-UP OF THE OXYGEN CONSUMATION OF DAPHNIA AS INDICATOR OF THE ADAPTATION TO DIFFERENT TOXIC SUBSTANCES (IN ROMANIAN),
W70-02368 05C

THE TOXIC ACTION ON PROTOZOA OF THE SUBSTANCES CONTAINED IN THE RESIDUAL WATERS OF THE ANTIBIOTIC PLANT, IASSY (IN ROMANIAN),
W70-02369 05C

IOWA STATE UNIV., AMES.
MATHEMATICAL ANALYSIS MODELS FOR QUANTITATIVE APPLICATION IN WATERSHED PLANNING,
W70-02380 06B

JOHNS HOPKINS UNIV., BALTIMORE, MD.
COMMENTS ON 'WATER POLLUTION CONTROL USING BY-PASS PIPING' BY A. W. GRAVES, G. B. HATFIELD, AND A. WHINSTON,
W70-02257 05G

JOHNS HOPKINS UNIV., BALTIMORE, MD. DEPT. OF SANITARY ENGINEERING AND WATER RESOURCES.
ALGAL GROWTH AND SEWAGE EFFLUENT IN THE POTOMAC ESTUARY,
W70-02255 02L

KAISER ENGINEERS, CHICAGO, ILL.
STEEL COMPANY BUILDS FLEXIBLE WASTEWATER TREATMENT SYSTEM,
W70-02176 05D

KANSAS STATE UNIV., MANHATTAN.
POTENTIAL EVAPOTRANSPIRATION AS INFLUENCED BY WIND,
W70-02143 02D

LABORATOIRE NATIONAL D'HYDRAULIQUE, CHATOU (FRANCE).
PROBLEMS OF BED LOAD TRANSPORT IN FRENCH WATERWAYS (FRENCH),
W70-02104 08B

LENINGRAD STATE UNIV. (USSR).
AEOLIAN MIGRATION OF WATER SOLUBLE MATTER AND ITS PROBABLE GEOCHEMICAL AND SOIL FORMATION SIGNIFICANCE,
W70-02421 02G

LIBRARY OF CONGRESS, WASHINGTON, D.C.
CONGRESS AND WATER RESOURCES,
W70-02160 06E

LITTLE (ARTHUR D.), INC., CAMBRIDGE, MASS.
PESTICIDES,
W70-02132 05G

MAINE FOREST SERVICE AND CONSERVATION FOUNDATION, WASHINGTON, D.C.
PESTICIDES AND STREAM INSECTS,
W70-02371 05C

MAINE UNIV., ORONO.
PERSISTENCE OF DDT IN CRAYFISH IN A NATURAL ENVIRONMENT,
W70-02357 05C

MAINE UNIV., ORONO. DEPT. OF CIVIL ENGINEERING.
HIGH-LEVEL INACTIVATION OF VIRUSES IN WASTEWATER BY CHLORINATION,
W70-02190 05D

MANHATTAN COLL., BRONX, N.Y. DEPT. OF CIVIL ENGINEERING.
STREAM EQUATIONS AND METHOD OF CHARACTERISTICS,
W70-02326 05A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY BIRLA INST. OF TECH. AND SCIENCE, PILANI (INDIA). DEPT. OF CIVIL ENGINEERING AND ROORKEE UNIV. (INDIA). DEPT. OF CHEMISTRY.
EFFECT OF PH ON THE RATE OF BOD OF WASTEWATER,
W70-02308 05A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
A DISTRIBUTED LINEAR REPRESENTATION OF SURFACE RUNOFF,
W70-02286 02E

MELPAR, INC., FALLS CHURCH, VA.
WATER RECLAMATION BY REVERSE OSMOSIS,
W70-02058 05D

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF GEOLOGY.
GEOCHEMICAL INVESTIGATION OF THE GROUNDWATER SYSTEM IN THE LANSING, MICHIGAN, AREA,
W70-02328 02K

MICHIGAN UNIV., ANN ARBOR. DEPT. OF RESOURCE PLANNING AND CONSERVATION.
ECOLOGICAL EFFECTS OF WEATHER MODIFICATION A PROBLEM ANALYSIS,
W70-02323 06G

MIDWEST RESEARCH INST., KANSAS CITY, MO.
AN INVESTIGATION OF LIGHT-CATALYZED CHLORINE OXIDATION FOR TREATMENT OF WASTEWATER,
W70-02090 05D

MILWAUKEE SEWERAGE COMMISSION, WIS.
FULL-SCALE OXYGEN TRANSFER STUDIES OF SEVEN DIFFUSER SYSTEMS,
W70-02175 05D

MINISTRY OF IRRIGATION AND POWER, NEW DELHI (INDIA).
ON SOME CHARACTERISTICS OF STORAGE DAM ASSOCIATED WITH RESERVOIR OPERATIONS,
W70-02111 04A

MINISTRY OF IRRIGATION (EGYPT). DELTA BARRAGE.
MODEL STUDY FOR THE PREVENTION OF SHOALING AT THE ENTRANCE AND EXIT OF ATHER-EL-NABI NAVIGATION CHANNEL.
W70-02109 08B

MINISTRY OF WORKS, WELLINGTON (NEW ZEALAND).
HYDROLOGY ANNUAL NO. 14 - 1966.
W70-02307 02E

MINISTRY OF WORK, WELLINGTON, (NEW ZEALAND). WATER AND SOIL DIV.
HYDROLOGICAL REGIONS OF NEW ZEALAND,
W70-02325 02A

MINNESOTA UNIV., MINNEAPOLIS. ST. ANTHONY FALLS HYDRAULIC LAB.
EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART I FLOW AND HEAT EXCHANGE NEAR A SURFACE OUTLET IN TWODIMENSIONAL FLOW,
W70-02393 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART II TEMPERATURE AND VELOCITY INSTRUMENTATION AND DATA PROCESSING FOR THE THREE DIMENSIONAL FLOW EXPERIMENTS,
W70-02394 02H

EXPERIMENTAL STUDY OF WARM WATER FLOW INTO IMPOUNDMENTS. PART III TEMPERATURE AND VELOCITY FIELDS NEAR A SURFACE OUTLET IN THREE-DIMENSIONAL FLOW,
W70-02395 02H

MISSISSIPPI POWER AND LIGHT CO., JACKSON.
A COOLING POND PROVES CHEAPER,
W70-02409 05D

MISSISSIPPI STATE UNIV., STATE COLLEGE AND AUBURN UNIV., ALA.
EFFECT OF RAINFALL ON THE VELOCITY DISTRIBUTION AND TRACTIVE FORCE IN A TRIANGULAR OPEN CHANNEL,
W70-02174 08B

MISSISSIPPI STATE UNIV., STATE COLLEGE.
TOLERANCES OF THREE SPECIES OF ANURAN AMPHIBIANS TO FIVE CHLORINATED HYDROCARBON INSECTICIDES,
W70-02345 05C

INSECTICIDE-RESISTANT FISHES A POTENTIAL HAZARD TO CONSUMERS,
W70-02350 05C

MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF ZOOLOGY.
CHARACTERISTICS AND SIGNIFICANCE OF RESISTANCE TO INSECTICIDES IN FISHES,
W70-02315 05C

SOURCES OF ERROR IN THE USE OF FISH-BRAIN ACETYLOCHOLINESTERASE ACTIVITY AS A MONITOR FOR POLLUTION,
W70-02349 05C

A SIMPLIFIED FLOW-THROUGH APPARATUS FOR MAINTAINING FIXED CONCENTRATIONS OF TOXICANTS IN WATER,
W70-02352 05A

MOSCOW STATE UNIV. (USSR).
GEOCHEMICAL DIFFERENTIATION OF PRODUCTS OF WEATHERING AND SOIL FORMATION ON THE RUSSIAN GREAT PLAIN,
W70-02428 02A

NATIONAL VEGETABLE RESEARCH STATION, WELLESBOURNE (ENGLAND).
THE INFLUENCE OF TEXTURE ON THE MOISTURE CHARACTERISTICS OF SOILS IV. A METHOD OF ESTIMATING THE AVAILABLE-WATER CAPACITIES OF PROFILES IN THE FIELD,
W70-02125 02G

NEBRASKA UNIV., LINCOLN.
EVAPORATION AND CONDENSATION ON BARE SOIL UNDER IRRIGATION IN THE EAST CENTRAL GREAT PLAINS,
W70-02144 03F

NEBRASKA UNIV., LINCOLN. DEPT. OF CHEMICAL ENGINEERING.
EFFECTS OF POLYFLUOROCARBON COATINGS ON SCALING IN EVAPORATORS WITH CONTINUOUS FEED CALCIUM SULFATE SOLUTIONS,
W70-02068 03A

NETHERLANDS RIJKSWATERSTAAT, ARNHEM AND WATERLOOPKUNDIG LABORATORIUM, DELFT (NETHERLANDS).
SAND TRANSPORT STUDIES RELATED TO THE CANALIZATION OF THE LOWER RHINE,
W70-02105 08B

NEVADA UNIV., RENO. DESERT RESEARCH INST.
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
W70-02110 06B

NEW BRUNSWICK UNIV., FEDERICTON. DEPT. OF BIOLOGY.
DEGRADATION OF DDT IN ATLANTIC SALMON (SALMO SALAR),
W70-02341 05C

NEW BRUNSWICK UNIV., FREDERICTON. DEPT. OF BIOLOGY.
IN VITRO DEGRADATION OF DDT BY INTESTINAL CONTENTS OF ATLANTIC SALMON (SALMO SALAR),
W70-02354 05C

NEW YORK STATE DEPT. OF HEALTH, ALBANY AND WASHINGTON UNIV., SEATTLE. WATER AND AIR RESOURCES PROGRAM.
COAGULATION OF PULPING WASTES FOR THE REMOVAL OF COLOR,
W70-02182 05D

NEW ZEALAND OCEANOGRAPHIC INST., WELLINGTON. DEPT. OF SCIENTIFIC AND INDUSTRIAL RESEARCH.
THE SEASONAL RANGE OF SEA TEMPERATURE ON THE NEW ZEALAND SHELF,
W70-02300 02L

NORTH CAROLINA STATE UNIV., RALEIGH.
RELATION OF AGRICULTURE TO GROUNDWATER POLLUTION A REVIEW,
W70-02161 05B

NORWEGIAN SCHOOL OF ECONOMICS AND BUSINESS ADMINISTRATION, BERGEN.
EQUILIBRIUM, OPTIMUM AND PREJUDICES IN CAPITAL MARKETS,
W70-02384 06B

NORWEGIAN WATER RESOURCES AND ELECTRICITY BOARD, OSLO. GLACIOLOGY SECTION.
GLACIOLOGICAL RESEARCH IN NORWAY, 1968 (NORWEGIAN),
W70-02084 02C

NOVA SCOTIA DEPT. OF MINES, HALIFAX. GROUNDWATER SECTION.
GROUNDWATER RESOURCES AND HYDROGEOLOGY OF THE ANNAPOLIS-CORNWALLIS VALLEY, NOVA SCOTIA,
W70-02309 02F

OAK RIDGE NATIONAL LAB., TENN.
DESALINATION RESEARCH AT OAK RIDGE,
W70-02117 03A

HYPERFILTRATION OF PLANT EFFLUENTS,
W70-02193 05D

OFFICE OF RESEARCH AND STATISTICS, WASHINGTON, D.C. LONG-RANGE RESEARCH BRANCH.
A SYSTEMATIC APPROACH TO A PRACTICABLE PLAN FOR STATE AID TO LOCAL GOVERNMENTS,
W70-02269 06B

OKLAHOMA STATE UNIV., STILLWATER. WATER RESOURCES RESEARCH CENTER.
AN EVALUATION OF RECENT APPROACHES FOR THE DESIGN OF BIOLOGICAL WASTE TREATMENT,
W70-02234 05D

ONTARIO WATER RESOURCES COMMISSION, TORONTO.
EFFECTS OF INSECTICIDES ON ALGAE,
W70-02198 05D

ONTARIO WATER RESOURCES COMMISSION, TORONTO. DIV. OF RESEARCH.
TRISODIUM NITRILOTRIACETATE AND ALGAE,
W70-02248 05C

OREGON STATE COLL., CORVALLIS.
PROGRAMMING STRUCTURES IN WATERSHED DEVELOPMENT,
W70-02383 06A

PENNSALT CHEMICALS CORP., PHILADELPHIA, PA. EQUIPMENT DIV.
CENTRIFUGES REDUCE WATER POLLUTION,
W70-02295 05G

PERMUTIT CO., PARAMUS, N.J. POLLUTION CONTROL APPLICATIONS.
SURFACE AERATION,
W70-02296 05G

PHILLIPS PETROLEUM CO., BARTLESVILLE, OKLA.
POLLUTION CONTROL BUILT INTO GUAYAMA PETROLEUM COMPLEX,
W70-02187 05D

PITTSBURGH UNIV., PA. DEPT. OF FORESTS AND WATERS.
SIMULATION OF OXYGEN UTILIZATION IN STORAGE-TREATMENT PLANT SYSTEM,
W70-02259 05D

PITTSBURGH UNIV., PA. GRADUATE SCHOOL OF PUBLIC HEALTH.
ION-SELECTIVE ELECTRODES -- THEORY AND APPLICATIONS IN WATER ANALYSIS,
W70-02112 05A

POLITEKHNICHESKII INSTITUT, LENINGRAD (USSR).
EXPERIMENTAL INVESTIGATIONS OF HYDRAULIC TURBINES WITH COMBINED RUNNERS,
W70-02138 08C

POLYTECHNIC INST. OF BROOKLYN, N.Y.
EVAPORATION FOR DESALINATION,
W70-02158 03A

PORTLAND CEMENT ASSOCIATION, SAN FRANCISCO, CALIF. WESTERN REGION.
SOIL-CEMENT LININGS FOR WATER-CONTAINING STRUCTURES,
W70-02281 08F

PRESSURE GROUT CO., DALY CITY, CALIF.
COMPACTION GROUTING TECHNIQUE AND OBSERVATIONS,
W70-02165 08D

PUBLIC HEALTH SERVICE, CLEVELAND, OHIO.
A PHYTOPLANKTON BLOOM IN WESTERN LAKE ERIE,
W70-02254 02H

PUBLIC WORKS, ESCONDIDO, CALIF AND HIRSCH AND KOPTICNAK, SAN DIEGO, CALIF.
TREATMENT AND REUSE OF INDUSTRIAL WASTEWATER,
W70-02177 05D

PUERTO RICO UNIV., MAYAGUEZ. WATER RESOURCES RESEARCH INST.
LOSS COEFFICIENT IN A CHANNEL BEND WITH NATURALLY DEFORMED BED,
W70-02287 08B

PURDUE UNIVERSITY, LAFAYETTE, IND.
FEASIBILITY OF COLD WEATHER EARTHWORK,
W70-02142 08D

PURDUE UNIV., LAFAYETTE, IND. DEPT. OF GEOSCIENCES.
ANALYSIS OF GROUNDWATER USE, REPLENISHMENT, AND AQUIFER CHARACTERISTICS IN BARTHOLOMEW COUNTY, INDIANA,
W70-02288 02F

QUEEN'S UNIV., KINGSTON (ONTARIO). DEPT. OF BIOLOGY.
THE EFFECTS OF AN ACUTE DDT EXPOSURE ON THE SPONTANEOUS ELECTRICAL ACTIVITY OF GOLDFISH CEREBELLUM,
W70-02361 05C

RENSSELAER POLYTECHNIC INST., TROY, N.Y.
GEOLOGY AND GEOCHEMISTRY OF REEFS, CARBONATE SEDIMENTS, AND WATERS, GULF OF AQABA (ELAT), RED SEA,
W70-02337 02L

RHODE ISLAND UNIV., KINGSTON. DEPT. OF CIVIL ENGINEERING.
SURFACE AERATION BY MECHANICAL AGITATION,
W70-02188 05D

ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO.
OZONE TREATMENT OF SECONDARY EFFLUENTS FROM WASTE-WATER TREATMENT PLANTS,
W70-02118 05D

ROBERT A. TAFT SANITARY ENGINEERING CENTER, CINCINNATI, OHIO. CINCINNATI WATER RESEARCH LAB.
CHEMICAL-BIOLOGICAL CONTROL OF NITROGEN AND PHOSPHORUS IN WASTEWATER EFFLUENT,

W70-02310 05D

ROBERT COLL., ISTANBUL (TURKEY).
MECHANICS OF BED FORMATIONS,
W70-02149 08B

ROTHAMSTED EXPERIMENTAL STATION, HARPENDEN (ENGLAND).
MEASUREMENT OF SOIL MOISTURE IN THE FIELD BY NEUTRON MODERATION,
W70-02124 07B

ROYAL NETHERLANDS METEOROLOGICAL INST., DE BILT.
ON THE DIFFUSION OF HEATED JETS,
W70-02402 02E

SACRAMENTO, CALIF.
CONTROL OF SEEPAGE IN EARTH DAMS,
W70-02164 04A

SHELL OIL CO., MIDLAND, TEX.
RECENT SEDIMENTS AND DIAGENESIS OF SOUTH BONAIRE, NETHERLANDS ANTILLES,
W70-02340 02L

SNOKIST GROWERS, YAKIMA, WASH.
AEROBIC TREATMENT OF FRUIT PROCESSING WASTES, A STUDY OF AERATED LAGOON, ACTIVATED SLUDGE AND ACTIVATED SLUDGE WITH SLUDGE REAERATION IN THE TREATMENT OF FRUIT CANNERY WASTE,
W70-02284 05D

SOIL CONSERVATION SERVICE, BELTSVILLE, MD.
AERIAL-PHOTO INTERPRETATION IN CLASSIFYING AND MAPPING SOILS.
W70-02066 07C

SOIL CONSERVATION SERVICE, HYATTSVILLE, MD.
CONSERVATION IN A NEW TOWN,
W70-02329 02J

SOIL CONSERVATION SERVICE, MADISON, WIS.
ROADSIDE EROSION SURVEY,
W70-02327 02J

SOIL CONSERVATION SERVICE, SPARTANBURG, S.C.
INTERDISCIPLINARY TEAMWORK IN WATERSHED PLANNING,
W70-02377 06B

SOIL CONSERVATION SERVICE, WASHINGTON, D.C.
WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT,
W70-02376 06B

SOUTH DAKOTA STATE UNIV., BROOKINGS.
EFFECTS OF MARGINAL QUALITY IRRIGATION WATER ON THE ACCUMULATION OF SALTS AND ALKALI IN SOUTH DAKOTA SOILS,
W70-02280 03C

SOUTH DAKOTA STATE UNIV., BROOKINGS. DEPT. OF ECONOMICS.
ECONOMIC EFFECTS OF USING SUBSTANDARD QUALITY WATER IN WEBSTER AND OTHER COMMUNITIES IN SOUTH DAKOTA,
W70-02051 03C

STANFORD RESEARCH INST., MENLO PARK, CALIF.
TIME-CAPACITY EXPANSION OF URBAN WATER SYSTEMS,
W70-02267 06D

STANFORD UNIV., CALIF.
NON-LINEAR PROGRAMMING AS A METHOD OF DESIGN OF TREATMENT FACILITIES FOR COMBINED SEWER EFFLUENT,
W70-02243 05D

STATE HYDROLOGICAL INST. (USSR).
EMPIRICAL FORMULA STRUCTURE FOR CALCULATION OF WATER SURFACE EVAPORATION (RUSSIAN),
W70-02232 02D

WIND REPRODUCTION AND WINDFLOW MEASURING METHODS USING SPATIAL MODELS (RUSSIAN),
W70-02233 02A

STATE HYDROLOGICAL INST., LENINGRAD (USSR).
WATER BALANCE AND RUNOFF UNDER THE CONDITIONS OF SUBSURFACE KARSTIC ENVIRONMENT (RUSSIAN),
W70-02219 02A

ANALYSIS OF FORMING AND DETERMINATION OF RAINFALL-RUNOFF LOSSES IN EASTERN CARPATHIANS (RUSSIAN),
W70-02222 02A

DETERMINATION OF MAXIMUM DISCHARGES OF RAINFALL FLOODS IN THE EASTERN CARPATHIANS RIVERS (RUSSIAN),
W70-02223 02A

MODELING OF ABRUPTLY VARYING STREAM CURRENTS (RUSSIAN),
W70-02415 02E

ANALYSIS OF CYCLIC FLUCTUATIONS OF ANNUAL RIVER DISCHARGES (RUSSIAN),
W70-02417 02A

ST. JOHN'S COLL., CAMBRIDGE (ENGLAND).
THE TIMESCALE OF ECONOMIC MODELS HOW LONG IS THE LONG RUN,
W70-02385 06A

TECHNION - ISRAEL INST. OF TECH., HAIFA. SANITARY ENGINEERING LAB.
EFFECT OF HALOGENS ON ALGAE - I. CHLORELLA SOROKINIANA,
W70-02363 05C

EFFECT OF HALOGENS ON ALGAE - II. CLADOPHORA SP.,
W70-02364 05C

EFFECT OF HALOGENS ON ALGAE - III. FIELD EXPERIMENT,
W70-02365 05C

ALGICIDAL EFFECT OF BROMINE AND CHLORINE ON CHLORELLA PYRENOIDOSA,
W70-02370 05C

CHLORINATION AS A MEANS OF CONTROLLING EARTHY ODORS IN RESERVOIRS,
W70-02373 05G

TENNESSEE DEPT. OF CONSERVATION, NASHVILLE. DIV. OF WATER RESOURCES AND GEOLOGICAL SURVEY, NASHVILLE, TENN.
GEOHYDROLOGY OF HENRY AND WEAKLEY COUNTIES, TENNESSEE,
W70-02071 03B

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA.
CONTROL OF TEMPERATURE THROUGH STREAMFLOW REGULATION,
W70-02407 05G

TENNESSEE VALLEY AUTHORITY, CHATTANOOGA. DIV. OF HEALTH AND SAFETY.
EFFECTS OF IMPOUNDMENTS ON WATER QUALITY,
W70-02411 02H

TENNESSEE VALLEY AUTHORITY, KNOXVILLE.
COMMENT ON 'PHILOSOPHY AND OBJECTIVES OF WATERSHED POLICY',
W70-02381 06B

TENNESSEE VALLEY AUTHORITY, NORRIS. DIV. OF WATER CONTROL PLANNING.
HEAT AND MASS TRANSFER BETWEEN A WATER SURFACE AND THE ATMOSPHERE.
W70-02401 02D

TENNESSEE VALLEY AUTHORITY, NORRIS. ENGINEERING LAB.
AERATION EFFICIENCY OF HOWELL-BUNGER VALVES,
W70-02189 05D

TEXAS A AND M UNIV., COLLEGE STATION.
A STATISTICAL STUDY OF THE DEPTH OF PRECIPITABLE WATER IN WESTERN TEXAS AND EASTERN NEW MEXICO,
W70-02096 03B

REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION, VOLUMES I AND II,
W70-02235 10

REQUIREMENTS FOR THE EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION. VOLUME III,
W70-02237 10

TEXAS A AND M UNIV., COLLEGE STATION. WATER RESOURCES INST.
REQUIREMENTS FOR EFFECTIVE USE OF THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER (WRSIC) - DETERMINED BY FIELD EVALUATION,
W70-02236 10

INVESTIGATION OF A LINEAR MODEL TO DESCRIBE HYDROLOGIC PHENOMENON OF DRAINAGE BASINS,
W70-02238 02A

TEXAS CHRISTIAN UNIV., FORT WORTH. DEPT. OF GEOLOGY.
CLAY MINERALOGY OF WEATHERED PRODUCTS AND OF RIVER SEDIMENTS, PUERTO RICO,
W70-02335 02J

TEXAS ELECTRIC SERVICE CO., FORT WORTH.
THERMAL REQUIREMENTS TO PROTECT AQUATIC LIFE IN TEXAS RESERVOIRS,
W70-02400 05B

TEXAS TECH UNIV., LUBBOCK. DEPT. OF AGRICULTURAL ENGINEERING.
DEVELOPMENT OF SYSTEMS FOR GROUNDWATER RECHARGE INTO THE OGALLALA FORMATION,
W70-02282 04B

TEXAS UNIV., AUSTIN AND ENGINEERING SCIENCE OF TEXAS, INC., AUSTIN.
ECONOMICS OF WASTEWATER TREATMENT,
W70-02191 05D

TEXAS UNIV., AUSTIN. DEPT. OF CIVIL ENGINEERING.
METHODS FOR EVALUATING THE EFFECTS OF UPSTREAM FLOOD CONTROL MEASURES ON WATERSHED YIELD,
W70-02322 04A

TEXAS UNIV., AUSTIN. ENVIRONMENTAL HEALTH ENGINEERING RESEARCH LAB.
THE OVERALL PICTURE OF EUTROPHICATION,
W70-02251 05C

TORONTO UNIV. (ONTARIO) AND SCARBOROUGH COLL., TORONTO (ONTARIO). DEPT. OF GEOGRAPHY.
SEDIMENT PARAMETERS AND ENVIRONMENT DISCRIMINATION AN APPLICATION OF MULTIVARIATE STATISTICS,
W70-02303 02J

TRW SYSTEMS GROUP, SAN BERNARDINO, CALIF.
MAKING ANALYTICAL TOOLS IN WATER RESOURCES MANAGEMENT USABLE,
W70-02265 06A

UKRAINSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT LESNOGO KHOZIAISTVA, KHARKOV (USSR).
DETERMINATION OF RAINFALL RUNOFFS USING PRECIPITATION AND MOISTURE CONTENT OF RUNOFF PLOTS CHARACTERIZED BY CLAYEY

SOILS AND GROUNDS (RUSSIAN),
W70-02227 02A

UKRAINSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT LESNOGO KHOZIAISTVA I AGROLESOMELIORATSII, KHARKOV (USSR).
RETAINING SURFACE RUNOFF ON AGRICULTURAL LANDS (RUSSIAN),
W70-02228 02A

UNDERWATER STORAGE, INC., WASHINGTON, D.C. AND SILVER, SCHWARTZ, LTD., WASHINGTON, D.C.
COLLECTION, UNDERWATER STORAGE AND DISPOSAL OF PLEASURECRAFT WASTE, FEASIBILITY OF CONNECTING SEWAGE HOLDING TANKS ON BOARD RECREATIONAL WATERCRAFT TO A DOCKSIDE COLLECTION SYSTEM AND STORAGE IN AN UNDERWATER TANK.
W70-02283 05G

UNIUNEA SOCIETATILOR DE STIINTE MEDICALE DIN REPUBLICA SOCIALISTA ROMANIA, BUCHAREST.
INFLUENCE OF CERTAIN TOXIC SUBSTANCES IN WATER ON THE MODIFICATIONS OF OXYGEN CONSUMPTION OF DAPHNIA MAGNA STRAUSS (IN ROMANIAN),
W70-02367 05C

UNIVERSIDAD CENTRAL DE VENEZUELA, CARACAS.
ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,
W70-02136 08B

UNIVERSITY COLL., LONDON (ENGLAND).
THE FORMATION OF FINE PARTICLES IN SANDY DESERTS AND THE NATURE OF 'DESERT' LOESS,
W70-02336 02J

UNIVERSITY OF SOUTHERN CALIFORNIA, LOS ANGELES. DEPT. OF PETROLEUM ENGINEERING.
DATA ON CONSOLIDATION OF FINE-GRAINED SEDIMENTS,
W70-02332 02J

UNIVERSITY OF STRATHCLYDE, GLASGOW (SCOTLAND). DEPT. OF CIVIL ENGINEERING.
SUSPENDED SOLIDS MONITORING A COMPARISON BETWEEN THREE INSTRUMENTS,
W70-02067 07B

UNIVERSITY OF THE WITWATERSRAND UNIV., JOHANNESBURG (SOUTH AFRICA). DEPT. OF CIVIL ENGINEERING.
DESIGN STORM DETERMINATION IN SOUTH AFRICA,
W70-02324 02B

UTAH STATE UNIV., LOGAN. COLL. OF ENGINEERING.
HYDRAULICS OF LARGE RED RIVER CHANNELS,
W70-02070 08B

UTAH WATER RESEARCH LAB., LOGAN.
SIMULATION OF THE HYDROLOGIC-ECONOMIC FLOW SYSTEM,
W70-02264 06A

VANDERBILT UNIV., NASHVILLE, TENN. DEPT. OF ENVIRONMENTAL AND WATER RESOURCES ENGINEERING.
IMPOUNDMENT EFFECT ON WASTE ASSIMILATION,
W70-02413 05C

VERMONT UNIV., BURLINGTON. DEPT. OF AGRICULTURAL ECONOMICS AND VERMONT UNIV., DEPT. OF ANIMAL AND DAIRY SCIENCE.
PRODUCTION, DISPOSAL, AND USE OF WHEY IN VERMONT,
W70-02299 05E

VERMONT UNIV., BURLINGTON. DEPT. OF BOTANY.
AUTECOLOGICAL STUDIES ON THE DOMINANT PHYTOPLANKTON SPECIES OF LAKE CHAMPLAIN,
W70-02247 02H

VICTORIA STATE RIVERS AND WATER SUPPLY COMMISSION (AUSTRALIA).
EQUIVALENT DISTRIBUTIONS WITH APPLICATION TO RAINFALL AS AN UPPER BOUND TO FLOOD DISTRIBUTIONS,
W70-02046 02A

VIRGINIA POLYTECHNIC INST., BLACKSBURG. DEPT. OF SOCIOLOGY.
PUBLIC PERCEPTION OF WATER RESOURCE PROBLEMS,
W70-02278 06B

VIRGINIA UNIV., CHARLOTTESVILLE.
WATER EVAPORATION SUPPRESSION,
W70-02276 03B

INFLUENCE OF SOLAR RADIATION REFLECTANCE ON WATER EVAPORATION,
W70-02277 03B

VOLGA RIVER HYDROMETEOROLOGICAL OBSERVATORY.
CALCULATION OF ALONG-THE-SHORE TRANSPORT OF SEDIMENTS IN ESTIMATING SHORELINE CHANGES OF RESERVOIRS (RUSSIAN),
W70-02230 02L

VOLGOGRAD AGRICULTURAL INST. (USSR).
THE PROBLEM OF MAKING WASTE WATER SAFE AND ITS USE IN IRRIGATING LIGHT CHESTNUT SOILS IN THE POVOLZHYE AREA,
W70-02424 03C

VORONEZH STATE UNIV. (SSSR).
METHODS FOR THE CALCULATION OF FLUCTUATIONS COEFFICIENTS OF SURFACE SPRING RUNOFFS FOR THE CONDITIONS REPRESENTED BY FOREST-STEPPE AND STEPPE ZONES OF THE EUROPEAN USSR (RUSSIAN),
W70-02224 02A

VROOMAN (MORRELL), GLOVERSVILLE, N.Y.
DESIGNING WASTEWATER TREATMENT PLANTS FOR SAFETY,
W70-02184 05D

WASHINGTON STATE WATER POLLUTION CONTROL COMMISSION AND WASHINGTON STATE DEPT. OF FISHERIES.
A REPORT ON THE RELATIVE TOXICITIES AND DISPERSING EVALUATIONS OF ELEVEN OIL-DISPERSING PRODUCTS,
W70-02343 05C

WATER POLLUTION CONTROL FEDERATION, WASHINGTON, D.C.
WASTEWATER TREATMENT,
W70-02196 05D

WATER RESEARCH ASSOCIATION, MEDMENHAM (ENGLAND).
ALTERNATIVE DIGITAL COMPUTER APPLICATIONS TO EVALUATE LINKED WATER RESOURCES,
W70-02256 06A

WATER RESOURCES ENGINEERS, INC., WALNUT CREEK, CALIF. AND TEXAS WATER DEVELOPMENT BOARD, AUSTIN.
SIMULATION/OPTIMIZATION TECHNIQUES FOR MULTI-BASIN WATER RESOURCE PLANNING,
W70-02266 06A

WATER RESOURCES ENGINEERS, INC., WALNUT CREEK, CALIF. AND WASHINGTON UNIV., SEATTLE.
WATER QUALITY MANAGEMENT AND THE TIME PROFILE OF BENEFITS AND COSTS,
W70-02311 05G

WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. HEAT TRANSFER DIV.
DESIGN AND OPERATION OF LARGE DESALTING PLANTS,
W70-02291 03A

WESTON (ROY F.), INC., WEST CHESTER, PA.
DYNAMIC OPTIMIZATION FOR INDUSTRIAL WASTE TREATMENT DESIGN,
W70-02261 05D

WISCONSIN UNIV., MADISON.
COMMENT ON 'WHERE DOES WATERSHED DEVELOPMENT FIT INTO THE TOTAL PICTURE OF RESOURCE DEVELOPMENT',
W70-02375 06B

WISCONSIN UNIV., MADISON. DEPT. OF CIVIL ENGINEERING.
THE APPLICATION OF SOME FUNDAMENTAL CHEMICAL EQUILIBRIUM CONCEPTS TO WATER SYSTEMS,
W70-02292 02K

WISCONSIN UNIV., MADISON. DEPT. OF WILDLIFE ECOLOGY AND CALIFORNIA UNIV., BERKELEY. DEPT. OF NUTRITIONAL SCIENCES.
SIGNIFICANCE OF CHLORINATED HYDROCARBON RESIDUES TO BREEDING PELICANS AND CORMORANTS,
W70-02342 05C

WISCONSIN UNIV., MADISON. DEPT. OF ZOOLOGY.
DEMONSTRATION OF THE ANTAGONISTIC ACTION OF LARGE AQUATIC PLANTS ON ALGAE AND ROTIFERS,
W70-02249 05C

ESTIMATIONS OF PHYTOPLANKTON PRODUCTION AND BIOMASS IN A SMALL ACID BOG LAKE,
W70-02252 02H

WISCONSIN UNIV., MADISON. INST. OF PLANT DEVELOPMENT, AND WISCONSIN UNIV., MADISON. DEPT. OF BOTANY.
QUANTITATIVE CATION REQUIREMENTS OF SEVERAL GREEN AND BLUE-GREEN ALGAE,
W70-02245 05C

WISCONSIN UNIV., MADISON. DEPT. OF WILDLIFE MANAGEMENT AND WISCONSIN ALUMNI RESEARCH FOUNDATION, MADISON.
AN EXPLORATION OF PESTICIDES IN A LAKE MICHIGAN ECOSYSTEM,
W70-02353 05C

WYOMING UNIV., LARAMIE. WATER RESOURCES RESEARCH INST.
WATER RESOURCE OBSERVATORY SOLAR RADIATION DATA-WATER YEAR 1969 AND PRIOR.
W70-02242 07C

YALE UNIV., NEW HAVEN, CONN. OSBORN ZOOLOGICAL LAB.
LIMNOLOGICAL STUDIES IN CONNECTICUT. VIII. THE NIACIN CYCLE IN A SMALL INLAND LAKE,
W70-02250 02H

ACCESSION NUMBER INDEX

09D	W70-02043
07C	W70-02044
07C	W70-02045
02A	W70-02046
03A	W70-02047
03A	W70-02048
05G	W70-02049
03A	W70-02050
03C	W70-02051
05B	W70-02052
07B	W70-02053
05B	W70-02054
03B	W70-02055
07B	W70-02056
02L	W70-02057
05D	W70-02058
03A	W70-02059
02E	W70-02060
06E	W70-02061
02E	W70-02062
03A	W70-02063
07A	W70-02064
03B	W70-02065
07C	W70-02066
07B	W70-02067
03A	W70-02068
05G	W70-02069
08B	W70-02070
03B	W70-02071
05A	W70-02072
02F	W70-02073
02J	W70-02074
07B	W70-02075
03B	W70-02076
03B	W70-02077
02E	W70-02078
07B	W70-02079
07B	W70-02080
03B	W70-02081
02L	W70-02082
02G	W70-02083
02C	W70-02084
04A	W70-02085
04A	W70-02086
04A	W70-02087
04A	W70-02088
04A	W70-02089
05D	W70-02090
02F	W70-02091
03D	W70-02092
05C	W70-02093
02L	W70-02094
04A	W70-02095
03B	W70-02096
02J	W70-02097
02L	W70-02098
02K	W70-02099
05B	W70-02100
02J	W70-02101
07B	W70-02102
08B	W70-02103
08B	W70-02104
08B	W70-02105
08B	W70-02106
08B	W70-02107
08B	W70-02108
08B	W70-02109
06B	W70-02110
04A	W70-02111
05A	W70-02112
03A	W70-02113
07C	W70-02114
07C	W70-02115
03A	W70-02116
03A	W70-02117
05D	W70-02118
02L	W70-02119
02E	W70-02120
02E	W70-02121
02E	W70-02122
02E	W70-02123
07B	W70-02124
02G	W70-02125
02G	W70-02126
06E	W70-02127
06E	W70-02128
06B	W70-02129
08E	W70-02131
05G	W70-02132
08A	W70-02133
03B	W70-02134
06E	W70-02135
08B	W70-02136
08G	W70-02137
08C	W70-02138
08C	W70-02139
08G	W70-02140
08D	W70-02141
08D	W70-02142
02D	W70-02143
03F	W70-02144
08E	W70-02145
08A	W70-02146
06E	W70-02147
09B	W70-02148
08B	W70-02149
06E	W70-02150
06A	W70-02151
06D	W70-02152
06B	W70-02153
04B	W70-02154
06B	W70-02155
06C	W70-02156
08C	W70-02157
03A	W70-02158
08E	W70-02159
06E	W70-02160
05B	W70-02161
08E	W70-02162
05G	W70-02163
04A	W70-02164
08D	W70-02165
08E	W70-02166
03E	W70-02167
06B	W70-02168
07B	W70-02169
08E	W70-02170
08C	W70-02171
08D	W70-02172
08D	W70-02173
08B	W70-02174
05D	W70-02175
05D	W70-02176
05D	W70-02177
05D	W70-02178
07B	W70-02179
05D	W70-02180
05D	W70-02181
05D	W70-02182
05D	W70-02183
05D	W70-02184
05D	W70-02185
05D	W70-02186
05D	W70-02187
05D	W70-02188
05D	W70-02189
05D	W70-02190
05D	W70-02191
05D	W70-02192
05D	W70-02193
06D	W70-02194
05D	W70-02195
05D	W70-02196
05D	W70-02197
05D	W70-02198
05D	W70-02199
02D	W70-02200
02G	W70-02201
02D	W70-02202
04C	W70-02203
04D	W70-02204
07C	W70-02205
04C	W70-02206
04D	W70-02207
04D	W70-02208
05C	W70-02209
08D	W70-02210
04A	W70-02211
04A	W70-02212
04A	W70-02213
04A	W70-02214
04D	W70-02215
04A	W70-02216
04C	W70-02217
02A	W70-02218
02A	W70-02219
02A	W70-02220
02A	W70-02221
02A	W70-02222
02A	W70-02223
02A	W70-02224
02A	W70-02225
02E	W70-02226
02A	W70-02227
02A	W70-02228
03F	W70-02229
02L	W70-02230
02J	W70-02231
02D	W70-02232
02A	W70-02233
05D	W70-02234
10	W70-02235
10	W70-02236
10	W70-02237
02A	W70-02238
05B	W70-02240
07B	W70-02241
07C	W70-02242
05D	W70-02243
02H	W70-02244
05C	W70-02245
05G	W70-02246
02H	W70-02247
05C	W70-02248
05C	W70-02249
02H	W70-02250
05C	W70-02251
02H	W70-02252
05C	W70-02253
02H	W70-02254
02L	W70-02255
06A	W70-02256
05G	W70-02257
05G	W70-02258
05D	W70-02259
04A	W70-02260
05D	W70-02261
02J	W70-02262
04B	W70-02263
06A	W70-02264
06A	W70-02265
06A	W70-02266
06D	W70-02267
06E	W70-02268
06B	W70-02269
05G	W70-02270
07B	W70-02271
06A	W70-02272
04A	W70-02273
04A	W70-02274
04A	W70-02275
03B	W70-02276
03B	W70-02277
06B	W70-02278
06B	W70-02279
03C	W70-02280
08E	W70-02281
04B	W70-02282
05G	W70-02283
05D	W70-02284
05G	W70-02285
02F	W70-02286
08B	W70-02287
02F	W70-02288
02L	W70-02289
03A	W70-02290
03A	W70-02291
02K	W70-02292
02E	W70-02293
05D	W70-02294
05G	W70-02295
05G	W70-02296
05G	W70-02297
02B	W70-02298
05E	W70-02299
02L	W70-02300
02K	W70-02301
02K	W70-02302
02J	W70-02303
05C	W70-02304
02E	W70-02305
02F	W70-02306
02E	W70-02307
05A	W70-02308
02F	W70-02309
05D	W70-02310
05G	W70-02311
04A	W70-02312
02A	W70-02313
07B	W70-02314
05C	W70-02315
02J	W70-02316
02E	W70-02317
02F	W70-02318
05D	W70-02319
02J	W70-02320
05B	W70-02321
04A	W70-02322
06G	W70-02323
02B	W70-02324
02A	W70-02325
05A	W70-02326
02J	W70-02327
02K	W70-02328
02J	W70-02329
02F	W70-02330
02J	W70-02331
02J	W70-02332
02J	W70-02333
02L	W70-02334
02J	W70-02335
02J	W70-02336
02L	W70-02337
02L	W70-02338
02J	W70-02339
02L	W70-02340
05C	W70-02341
05C	W70-02342
05C	W70-02343
05C	W70-02344
05C	W70-02345
05C	W70-02346
05C	W70-02347
05C	W70-02348
05C	W70-02349
05C	W70-02350
05C	W70-02351
05A	W70-02352
05C	W70-02353
05C	W70-02354
05C	W70-02355
05C	W70-02356
05C	W70-02357
05C	W70-02358
05C	W70-02359
05C	W70-02360
05C	W70-02361
05C	W70-02362
05C	W70-02363
05C	W70-02364
05C	W70-02365
05C	W70-02366
05C	W70-02367
05C	W70-02368

05C W70-02369
05C W70-02370
05C W70-02371
05C W70-02372
05G W70-02373
06B W70-02374
06B W70-02375
06B W70-02376
06B W70-02377
06B W70-02378
06A W70-02379
06B W70-02380
06B W70-02381
06B W70-02382
06A W70-02383
06B W70-02384
06A W70-02385
06B W70-02386
06E W70-02387
06B W70-02388
06B W70-02389
06A W70-02390
06C W70-02391
05G W70-02392
02H W70-02393
02H W70-02394
02H W70-02395
05D W70-02396
02H W70-02397
05B W70-02398
05B W70-02400
02D W70-02401
02E W70-02402
05B W70-02403
02H W70-02404
05B W70-02405
02H W70-02406
05G W70-02407
07C W70-02408
05D W70-02409
05B W70-02410
02H W70-02411
02F W70-02412
05C W70-02413
05B W70-02414
02E W70-02415
02G W70-02416
02A W70-02417
03C W70-02418
03C W70-02419
06B W70-02420
02G W70-02421
02G W70-02422
02G W70-02423
03C W70-02424
02G W70-02425
02G W70-02426
02G W70-02427
02A W70-02428
03C W70-02429
02G W70-02430
02A W70-02431
05G W70-02432
02G W70-02433
02G W70-02434
03E W70-02435
03E W70-02436
02C W70-02437
02I W70-02438
02G W70-02439
02G W70-02440
02G W70-02441
05B W70-02442

ABSTRACT SOURCES

Source	Accession Number
A. Centers of Competence:	
University of Texas - Municipal Wastewater Treatment	W70-02175 -- 02199*
Bureau of Reclamation - Engineering Works	W70-02127 -- 02174
University of Florida - Eastern U.S. Water Law	W70-02049, 02061, 02127, 02128, 02135, 02150, 02163, 02268
U.S. Geological Survey - Hydrology	W70-02043 -- 02126 02218 -- 02234 02286 -- 02314 02316 -- 02340 02415 -- 02419
University of Wisconsin - Eutrophication	W70-02244 -- 02255
Cornell University - Policy Models for Water Resources Systems	W70-02256 -- 02275
University of Arizona - Arid Lands Water Resources	W70-02420 -- 02441
University of Washington - Water Quality Requirements for Aquatic Organisms	W70-02341 -- 02373 02315
Rutgers - The State University - Water Resources Economics	W70-02374 -- 02390 02269
Vanderbilt University - Thermal Pollution	W70-02396 -- 02414
B. Others:	
Federal Water Pollution Control Administration	W70-02283 -- 02285 02392 -- 02395
U.S. Forest Service	W70-02200 -- 02217
National Agricultural Library	W70-02150, 02156, 02164, 02169, 02179, 02194, 02260, 02262, 02263, 02268, 02273, 02274, 02275, 02281
Texas Water Resources Institute	W70-02235 -- 02238 02282
North Carolina Water Resources	W70-02239
Arkansas Water Resources Research Center	W70-02240
South Carolina Water Resources Research Institute	W70-02241
Wyoming Water Resources Research Institute	W70-02242

* Numbers are generally inclusive, except for numbers not used and individual items listed under other entries.

ABSTRACT SOURCES

Source	Accession Number
Stanford University	W70-02243
Virginia Water Resources Research Center	W70-02276 -- 02278
Georgia Water Resources Center	W70-02279
South Dakota Water Resources Institute	W70-02280
Illinois Water Resources Center	W70-02391
Colorado Natural Resources Center	W70-02442

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

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